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Hands Across to Japan.

Step by step since 1902 the work has gone on of laying the Commercial Cable network in the Pacific Ocean, and it is with great pleasure that we note this week what may be regarded as the natural completion of the enterprise in bringing Japan into the system. President Roosevelt and Emperor Mutsuhito have exchanged felicitations in cordial and appropriate language that expresses their sense of the importance of this link, putting the Tokio office of the company in direct communication with Guam, and thence with the other lines. Japan and the United States have recently become great Pacific powers at the same moment; their relations are intimate and friendly, and this American cable has its rôle to play in the promotion of intercourse between the New World and New Asia.

We can but offer sincere and hearty congratulations to Mr. Clarence Mackay on the patience and skill with which he has thus seen his father's great enterprise in the Pacific Ocean rounded out successfully. Mr. John W. Mackay, to our way of thinking, has never yet been appreciated for the great man he was as a creator of wealth and industries, forceful, fightful, formidable, tenacious of purpose and large-hearted. He has been fortunate in handing on his big schemes and undertakings to competent hands; and America owes the Mackay family much for this addition to its resources of civilization. It is really a fine thing to record that the elder Mackay, despite legislative obstacles, scornful of subsidies, and indifferent even to governmental competition, went ahead bravely in 1902 and launched out undismayed and undeterred on the noblest piece of cable work the world has seen. For the span of cable from San Francisco to the Philippines is 8,000 miles, the depths are the greatest ever encountered, the absence of stations is extreme, and the possibility of financial return has not been excessive. But Mr. Mackay secured the best resources in talent and experience that Europe could furnish, and though his own sudden death intervened, the work went on in the hands of his capable associates, until it is now a grand accomplished task. A brief five years have sufficed to connect this country up with the Sandwich Islands, the Philippines, China and Japan, and in the history of the enterprise not the least important fact to dwell upon will be the celerity with which the 1,065 miles to Honolulu and the 8,000 odd miles to Manila were completed; the speed of laying apparently was accelerated toward the close.

We do not know how many more girdles will be put around the ribs of the world, but other outgrowths of the Mackay system can be readily imagined. For the network that now exists the traffic is said to be larger than was expected; while Oriental intercourse with our Western shores is obviously bound to increase. The perfection of wireless systems has evidently not yet been pushed so far as to deprive cables of business, or to deter capital from investing in such enterprises for fear of inadequate revenues.

Suburban Transportation.

The suburban transportation of our great cities is rapidly becoming electrified, and this summer sees more of electric trac-

tion for commuter service than ever; while all the new plans are along the same lines of development. Around New York, as on certain parts of the Long Island system, the benefits are already apparent, and later in the year there is promise of the change on the New York Central system. One of the incidental results has been a real estate boom of unsurpassed proportions and enthusiasm. Some of the prophecies attendant on the boom electricity will undoubtedly enable the seers to fulfill; other extravagant forecasts are beyond the ability of any motive power or body of men to "make good." The main thing is that a large bulk of the city population sees a hope of release from cramped rooms and flats that it had never dare indulge before; and many people are being tempted to consider the desirability of a country home who hitherto were deterred by dislike of stuffy steam travel, smoky tunnels and infrequent trains.

The stuffy steam travel and the smoky tunnels are "going," going rapidly, but many shrewd observers are watching the effect of electricity on the train schedule. One great ability of electric power is that of permitting the traffic manager to make incessant dispatch of smaller units. The bunching and congestion of traffic is thus avoided. The general theory of steam passenger traffic still in vogue has been to crowd all the business into one mass that the locomotive can get away with. We make bold to assert that the present managers of converting steam roads are still mentally subject to the old fetish of the locomotive, and that having found in the "multiple unit" system a substitute that gives them swifter acceleration with all the power to carry the old load, they are working the "multiple unit" for more than it is worth to the passenger. The "multiple unit" is for use rather than abuse, and one of its great neglected merits is its capacity for handling small trains at frequent intervals and high speed. Let us see a little more of that in electric suburban travel.

American Individualism.

The members of the Municipal Ownership Committee of the National Civic Federation sent over to investigate the working of municipal plants and public service corporations are having a very nice time in England, and will now be taking a "look in" on the continent for the same purpose. They will bring back some very useful facts and figures with them, for they have been working hard, and some of the plants visited are quite interesting. But while the data will be of common acceptance in all probability, it is more than likely that there will be two sets of reports predicated upon them. The opinions and point of view will remain the same, we think, with all the commissioners, no matter what the data are. Mr. Ingalls pointed this out during the current week at a reception in London to the commission, when he intimated also that even if we had in America what we have not—a large supply of men who can give their time for nothing to public affairs—there would still be the choice to make between the socialism that masks in Europe under the guise of monarchism, or the persistent individualism that drove men to America for freedom of thought and action, and that has won practically all our triumphs. Recent political and economic history in America would indicate that the lawmaking power can preserve the individual, while leaving play for united effort in social and business life.

The Interpole Motor.

At the recent Milwaukee General Meeting of the American Institute of Electrical Engineers, one of the most interesting discussions was on the interpole type of motor, and the participation therein of engineers connected with a half-dozen manufacturing companies served to point out and emphasize that much which is relatively new and of increasing importance is to be expected from the application of that old and well-known device, the commutating pole. By the use of such poles the designer is free to select dimensions without reference to the limitations imposed by commutation; higher rotative speeds may be employed, thus obtaining greater outputs for the same material; and variable speeds may be obtained with ease from motors of both the series-wound and the shunt-wound types. It is difficult to predict the extent to which the commutating pole will be employed. It is safe to assume, however, that it will make itself felt more and more in electric railway and elevator motors and in high-speed turbo-generators, in addition to its present use in machine tools and similar changeable-speed work.

Graphical Treatment of Higher Harmonics.

On page 1338 Mr. R. E. Hellmund describes an interesting graphical method for determining the current which flows through impedances of different constants when subjected to a non-sinusoidal electromotive force. It is shown that when the complex e.m.f. is impressed upon a pure non-inductive resistance, a pure inductive reactance, or a pure condensive reactance, in each case each harmonic tends to produce a definite component of current just as though the other harmonics were not present. Thus, when such simple circuits are connected in parallel the currents due to the component harmonics can be added vectorially by the method commonly employed with assumed sinusoidal currents. Although the method proposed by the author can be so modified as to include inductive and condensive reactances and resistances in series or in series-parallel, and thereby to correspond more nearly with conditions as they exist, the graphical representation becomes exceedingly involved. Moreover, in any case the method necessitates an accurate resolution of the e.m.f. wave into its component parts. It would seem that the most convenient method for the general problem is the one which assumes the existence of a definite sinusoidal e.m.f. wave of fundamental frequency, with definite third, fifth, etc., harmonics, each wave being treated separately by algebraic methods. The several harmonic currents having been determined, the resultant can be ascertained as the square root of the sum of the squares of the various currents, effective values being used throughout. It is noteworthy that when the several components of currents of each harmonic in pure inductive and non-inductive circuits have been found it is unnecessary to determine the resultant harmonic current due to placing these circuits in parallel, because their squares can be added directly to give the total sum whose square root represents the effective value of the composite current. However, for the combination of currents of the same frequency, and especially for the location of the superposed upper harmonics upon the fundamental of the current wave, the graphical method possesses the advantage of combined simplicity and convenience.

The Transformer Efficiency of Telephonic Induction-Coils.

The alternating-current transformer is not confined to power-distribution circuits. One of its most extensive applications is in the field of telephony. Every subscriber keeps a private in-

duction coil on his premises. The purpose of the transformer in this case is to raise the alternating-current voltage generated by the action of the diaphragm transmitter. The action involved in the telephone transformer is extremely complex. A high voltage is desirable, and so, on that account, is a large ratio of transformation. On the other hand, however, a large ratio of transformation increases the waste of energy in the transformer, and thus, beyond a certain limit, defeats its own object. The secondary winding impedance is an objectionable feature at the receiving end of the line, reducing the strength of the received telephonic currents, both by I^2R and reflection losses. The best transformer for the sending end of the circuit is not, in general, the best for the receiving end. Moreover, as pointed out in the article on this subject by Mr. D. MacL. Therrell, on page 1344, the best transformer for one vocal frequency is not the best for another, so that in composite-frequency speech, a general average of best efficiency has to be sought for. A particular arrangement of circuits is described in the article, somewhat complex in appearance, which it is claimed is particularly advantageous over long-distance aerial telephone circuits. Assuming, however, that the particular disposition described has advantages on long-distance aerial circuits, it remains to be shown that it would also be superior on long-distance underground circuits, both plain and loaded. There is often a long stride between the best conditions possible and the best conditions capable of use in a large telephone system, where every variety of length and character of circuit may be found. It is not to be denied that the efficiency of the telephone transformer is low. It is much easier to criticise this transformer than it is to replace it with a better at a reasonable cost and in such a manner as to be readily incorporable with the large telephone systems of to-day.

MEASUREMENT OF FEEBLE HIGH-FREQUENCY CURRENTS.

Along with the development of kiloampere measurement, in the electric distribution of power, goes the measurement of microampere measurement in the electric distribution of ideas, by telephony. The little microampere is just as necessary to the transport of thought and speech in telephony as is the big kiloampere from a large turbo-alternator, to the transport of power. The apparatus needed for the measurements of these widely separated quantities is very different; but the same laws apply to the great as to the small. There is nothing aristocratic about electricity, nor blue blood in the electric fluid. The article this week on page 1341 by Herr Bela Gati on the measurement of very feeble telephonic currents indicates a direction in which we may expect new developments in microampere measurement. He employs the Fessenden solid barretter of minute platinum wire. Commencing with platinum wire ten micrometers in diameter, the finest he could at first obtain in all Europe, he has succeeded in inducing manufacturers to produce wire as fine as half a micrometer, which is about the length of a wave of green light.

Fine platinum wires are of great value in alternating-current measurements. In comparatively larger sizes they are employed to measure a few centiamperes, as in the Cardew voltmeter or the "hot-wire" expansion instruments so useful for switchboard purposes. In the delicate sizes of a few micrometers diameter they are capable of measuring currents of a few microamperes, as in telephony, or in wireless telegraphy. The finer the wire, the greater the care that has to be taken against accidental burn-outs. There is no difficulty in producing such a wire which will fuse at one milliampere, and at the diameter of half a micron, mentioned by Herr Gati, which is less than we have seen used here, the fusing current, *in vacuo*, should be only a fraction of a milliampere.

THE SIMPLE CIRCLE DIAGRAM OF THE SINGLE-PHASE INDUCTION MOTOR.

The article of Dr. A. S. McAllister on page 1339 of this number forms a fitting sequence to his earlier article on the polyphase-motor circle diagram of May 26. It was there shown that from the tests of a polyphase motor both at no-load speed and at standstill, a circle can be quickly plotted, such that the locus of the primary current will conform therewith, for all intermediate loads, within a practically satisfactory degree of approximation. From an inspection of this circle, the behavior of the motor can be satisfactorily predicted at any or all loads. In the present article it is shown that when a polyphase induction motor is compelled to operate as a single-phase machine, by cutting one of the supply wires its current locus is still approximately a circle; but the circle shrinks in diameter about 50 per cent. This means that the losses in the machine will be increased for any given load that the machine can carry, and also that the capability of the machine to carry load will be reduced, or its output diminished, as might be expected. The curious condition is also determined from simple calculations that whereas the speed of a polyphase induction motor, taking synchronous speed as unity, is equal to the secondary efficiency, in the same motor limping along as a single-phaser, the speed is equal to the square root of the secondary efficiency. This proposition must apply to all single-phase induction motors.

It is a very fortunate circumstance that the current diagram of single-phase motors, as well as polyphase motors, may be practically regarded as circular, because the conditions in single-phasers are comparatively complex, and their simplification for engineering purposes is all the more welcome. It is true that we may not expect to have large single-phasers, but we may expect to have a large number of small ones. A single-phase induction motor develops at zero speed a simple alternating or reciprocating magnetic field. By the well-known kinetic analogy this may be regarded as equivalent to a pair of equal pure synchronously rotating magnetic fields revolving in opposite directions. Each of these components will take half the magnetic flux and supporting primary current. At standstill, the rotor is unable to make up its mind which way to turn, or which of the two virtual rotating fields to follow. Any mechanical or magnetic dissymmetry, however, such as an impulse, or an auxiliary condenser circuit, may permit the rotor to make up its mind and to initiate rotation in one or other direction. As soon as the rotor turns, the currents induced therein by the component field that the rotor follows set up an increasingly powerful accelerating torque, while the component that the rotor is running away from sets up parasitic currents that have but little dynamic effect. At full speed, therefore, as Dr. McAllister's diagram indicates, we have the preponderating revolving component or half-field driving the motor, while the other half acts as a virtual leak of definite admittance depending on the speed and placed across the primary terminals. There can be no doubt that the approximation circle diagram gives to alternating-current engineers a distinct benefit in simplifying the behavior of induction motors.

Important Electric Railway Legislation in Massachusetts.

Advices from Boston state that a sweeping bill designed to prevent foreign railroad corporations from purchasing Massachusetts street railway companies and forcing foreign companies to reliquish any such railways which they may control, has come before the Committee on Rules of the House on the question of the admission of the measure for consideration. The bill as drafted would affect particularly the New York, New Haven & Hartford Railroad. The suggested restriction of foreign railroad corporations follows a decisive defeat of the so-called "merger bill," which was pending in the Legislature for some time, and which gave domestic railroad corporations the same privileges to acquire street railway companies as is legally enjoyed by those under foreign charter. The following message was received in the Legislature from Governor Guild on the subject:

"I congratulate you on the defeat of a measure that would have sanctioned the possible consolidation of all transportation in Massachusetts under the control of a single corporation. The present railroad system, however, is most unjust and unequitable. Our steam railroad system is forbidden to meet the competition of electric street car lines by purchase or control of their stock, but another controlled by men who are not citizens of Massachusetts is not only permitted to exercise that privilege, but is exercising it to-day to such an extent that healthy competition in Western Massachusetts is almost throttled.

"Slowly, surely, the control of our own railroads, the control of the passage to market of every product, the control of the transportation to and from his work of every Massachusetts citizen, is passing from our hands to those of aliens. I therefore urge upon you with all the strength that is in me the passage of some legislation giving relief from the grave injustice. Let Massachusetts announce that transportation within her borders is in the future to be controlled by the people of Massachusetts and not by men beyond the reach of her laws and the inspiration of her ideals."

After a conference of various committee chairmen of the House, it was agreed that the Railroad Bill and Governor's message should have a public hearing during the current week.

Chicago Lighting Franchises.

As has been previously noted in these columns, a committee of the Chicago City Council has for some time been drawing up an ordinance providing for the reduction of electric light rates in that city. To aid it in its work, it employed as experts Messrs. Bion J. Arnold and William Carroll to make a report. As a result an ordinance was drawn up providing for several reductions in rates during the next five years. These rates were agreed to by the Chicago Edison and Commonwealth Electric Companies. Along with this ordinance another provision was made for the consolidation of the Chicago Edison Company and the Commonwealth Electric Company, both of which companies are owned by the same interests. The City Council passed this ordinance, but Mayor Dunne vetoed it and the Council has now upheld the veto. The veto of this ordinance, however, will have but little effect on the value of these companies' franchise rights. The Commonwealth Electric Company has a franchise which does not expire until 1947. This franchise covers the entire city. The Chicago Edison Company has a franchise which expires in 1912, at the end of which time its property, according to the present plans, is to be transferred to the Commonwealth Electric Company. The chief reason for the failure of the ordinance to pass over the Mayor's veto seems to have been that some question was raised as to whether some clauses in the ordinance would not give the Commonwealth Electric Company an opportunity to escape the payment of 3 per cent of the gross receipts on certain business upon which they would otherwise have to pay this percentage. The result of the whole matter is that electric lighting rates remain the same in Chicago as they were before, although undoubtedly some other ordinance will be passed later without provision for anything but a reduction of rates.

Work of the Department of Electricity in San Francisco.

A very interesting report covering the work accomplished by the Department of Electricity of San Francisco during April and May has been submitted by Chief William R. Hewitt, to the Fire and Police Commissioners of that city. As the report covers the work of the Department during the fire and immediately after, the following extract is of interest:

"Fees collected April 1 to 18, $586; fees collected from April 18 to June 1, $12.75; inspections of new wiring in buildings, April and May, $1,500; inspections of old buildings, April 18 to June 1, $7,000; certificates issued for new wiring, $90; permits issued to resume current on railway, lighting and telephone routes, April 22 to May 1, $15.

"There were 39 pieces of line trouble removed in April and 28 in May. Alarms of fire received during the month of April were fifty-two firsts, four seconds, one third and eighteen directs, making a total of seventy-five. In May there were only twenty-one firsts, one second, seven thirds, total, 29 alarms of fire.

"Concerning the operations during and immediately following the earthquake and fire I beg to report that on April 18 I arrived at the fire alarm office on Brenham Place at 5.40 o'clock and found it completely wrecked (with the exception of a couple of working lines), the batteries having been thrown to the floor, which was littered with a great deal of glass and covered with water, and the chimney and fireplace had caved in, causing a small blaze, fortunately extinguished before any serious damage was done.

"With the two operators and the lineman on duty I proceeded to re-establish the office—an almost impossible task under the circumstances. Linemen and other employees were soon arriving and several of them were dispatched for horses and wagons with which to haul material from the supply houses for restoring the signal system, while some were detailed clearing and removing fallen brick and debris.

"This work proceeded until about 9 o'clock a.m., when, after a survey of the progress of the fire, I realized the possibility of the central office being burned out with the remainder of the district. Leaving orders to proceed with the work, however, I went to the City Hall to arrange to re-establish connections there if possible. I found the switchboard in the City Hall office entirely unharmed, but with the fire raging, apparently unchecked, immediately south of Market Street.

"On returning to Brenham Place, the fire had made such progress that it was evident our efforts would be useless, and with the wagon and four or five men, I returned to the City Hall to remove the records and such instruments and material as might be necessary in re-establishing our signal office in a new location entirely removed from the reach of the fire; but, unfortunately, we were prevented from entering the building by a guard of Federal troops, who refused to listen to any argument or supplication whatever for the removal of our office, telling us their orders were to permit nobody to enter the building.

"The men with me were then ordered to meet at Brenham Place that afternoon, in order that if the fire had been brought under control we could proceed to restore our system and office. At 2 o'clock the conflagration was so close at hand that, with two linemen, we proceeded to dismantle the office and remove the instruments to Portsmouth square, leaving a sufficient number on the switchboard to enable us to open immediately, after a forlorn hope that the fire might not reach the central office. The conflagration raged in the vicinity of Brenham Place all that evening, and finally burned our central office between 12 and 1 o'clock.

"Thursday and Friday the raging fire made it impossible—in fact, unnecessary—to re-establish any signal system, because the entire Fire Department was fully occupied in battling with the general conflagration.

"Friday night, at 11:30 p. m., a survey of the lines showed that the fire had apparently been brought under control, and all linesmen and other employees who were available were notified to assemble at Lafayette Square the next day at 12 o'clock for re-establishing our system.

"At 10 a. m. Saturday I had secured the quarters of the upper flat at 2034 Steiner Street, and with the men arriving hourly we proceeded to take up the ends of our business and install a central office. Such instruments as we had saved were utilized, and the lines hurriedly run in, and from Saturday evening we were prepared to handle such alarms as might be sent in, and by Monday morning at 8 o'clock the unburned district was practically covered and protected by fire signal service.

"Saturday morning copies of a notice were given to the daily papers to the effect that all alarms of fire could be sent to the telephone company over their available lines, and in turn would be reported to our office across the street, which we would immediately transmit over our tapper lines until such time as our signal lines were in working order, and the Mayor was notified of this action, together with our action in taking 2032 Steiner Street, of which his honor was pleased to approve.

"It was necessary that provision for food, clothing and quarters be made for our men, so a commissary was organized, and by Saturday evening, April 21, we were in a position to supply eighty men with three meals a day—and this was continued until May 10, when the men had had time and opportunity to re-establish their homes.

"In the meantime our signal system had been fully restored in all unburned districts throughout the city, and we have resumed our old order of system and operation. We are to-day rapidly extending the system into the burned district and keeping pace with all reconstruction throughout the city.

"The estimated loss to the department on account of the earthquake and fire amounts to about $177,400, itemized as follows:

Central office at City Hall	$40,000
Damage to underground system	40,000
Overhead construction	35,000
Engine-house equipment	18,500
Fire boxes	16,600
Police boxes	15,000
Central office, Brenham place	7,500
Police station equipment	4,800
Total loss and damage	$177,400

Lighting and Power in San Francisco.

The work of lighting the streets in the burned district of San Francisco is being energetically pushed and within a short time the greater part of the area will be furnished with an adequate system of electric arc lights. On Market Street the San Francisco Gas & Electric Company has strung overhead service wires between the trolley poles of the United Railroads and hung arc lamps on the span wires close to the curb line at every other pole. This work has been completed on the north side of the street, from the ferry to Valencia Street, the construction being but temporary.

Some time before the fire the San Francisco Gas & Electric Company was given the contract for furnishing street lights by the Board of Supervisors, this being a part of the existing schemes being promoted for the beautifying of San Francisco. The corporation agreed to furnish poles of an ornamental design for Market Street, from the ferries to Valencia, and the work was to be done on this one street during the year.

This plan, however, is entirely separate from the proposal of the United Railroads for beautifying the main streets traversed by the lines of their system. After the fire the United Railroads voluntarily offered to furnish the city, free of charge, a system of street lights for Market Street and also Sutter Street. When this voluntary offer was made it was the idea of the railroad company to supply poles of a special design to be selected by the city. They declare that they stand ready to carry out their original plans for supply lights for these two thoroughfares as soon as the more urgent work of re-establishing street car service along such of their lines as were put out of commission by the fire is completed.

When the application of the Presidio and Ferries Railroad Company for a franchise to operate the overhead trolley system over its lines was made recently the question of street lights was brought up by some of the members of the Board of Supervisors, with a view to having this company assist in the establishment of a system of street lights along the lines operated by the company.

The United Railroads is now receiving practically all of its power from the California Gas & Electric Corporation's transmission system. About 18 months ago the corporation closed a contract with the United Railroads to supply all the electric power needed for the operation of the railroad's cars in San Francisco for a period of twenty years, beginning January, 1906. In order to guard against interruption of the service from failure of the long-distance transmission lines the electric company began the erection of a gas-engine plant and power station in Visitacion Valley, just across the city line in San Mateo County. Their plant is designed for 12,000 kw, or sufficient to pick up the entire load on the United Railroads' system within two minutes. It was near completion at the time of the earthquake and fire, the electric company having been granted one or two extensions on its contract, due to the delay in receiving some of the gas engine machinery.

The Visitacion Valley plant, or Martin plant, as it is called after Mr. John Martin, was slightly damaged by the earthquake, but it is being rushed to completion in order to provide sufficient reserve for the street railway peak load and also to ensure an uninterrupted service. Meanwhile the railway load is being carried entirely from the hydro-electric stations.

The general power load of the California Gas & Electric Corporation has not yet been built up to its old proportions in San Francisco, but, on the other hand, the demands for power in all the bay cities have increased very rapidly and the company is having its hands full in providing sufficient capacity for all new consumers.

Electrification of the Erie.

The management of the Erie Railroad, which, with commendable foresight towards a constant betterment and improvement of that immense railroad system, has for the last two years conducted a thorough investigation into the possibilities of electricity as a railway motive power, decided at a recent meeting of the Board of Directors, as already announced in these columns, to take the initial steps for operating electric trains by contracting with Westinghouse, Church, Kerr & Co. for the installation of an electric system on its Rochester & Mount Morris Division, a distance of 35 miles. This decision of the Erie Railroad management seems to be of the greatest importance when the facts are taken into consideration which led up to it. The company's electrical board consists of such eminent engineers as J. M. Graham, B. J. Arnold, L. B. Stillwell and A. M. Williams. Mr. Graham has been on a personal tour of inspection of electric railway systems in this country, as well as in Europe, and there cannot be any doubt that the recommendation of this board in favor of electricity is about as high an approval as electric railway propulsion could ask for. The system which the board of the Erie has decided to adopt is the Westinghouse single-phase alternating-current railway system, the same as is now being installed by the New York, New Haven & Hartford Railroad Company.

The preliminary contract with Westinghouse, Church, Kerr & Co. calls for the electrification of 35 miles of the company's line from Rochester to Mount Morris, the equipment of a transformer station and the installation of seven electric cars. These cars will be operated by single-phase motors, probably four of 150 hp capacity each to one car. The line construction calls for the single-phase catenary trolley system. The cars will be used to haul passengers; there will also be freight cars. The power for the operation of the road is to be obtained from the Niagara Falls power plant.

It has been the custom with many steam roads to allow the paralleling of their lines by trolleys. This had a result which invariably proved costly to the steam road, because the parallel electric road as a rule began by making inroads on the local passenger traffic, then obtained the express traffic, and at last absorbed the local freight. The outcome was that the steam road had to buy out its younger competitor. In the case of the Erie, this is obviated.

Pacific Coast Transmission Convention.

The annual convention of the Pacific Coast Transmission Association was scheduled to be held in San Francisco or vicinity on June 19 to 21. However, the earthquake and fire of April 18 and the resultant conditions have made it inadvisable to call any meeting for this summer. The members of the association are among the most actively engaged in the rebuilding of the city and in carrying on the necessary engineering work incident thereto and it was deemed by the officers that the association would do better to omit this year's convention, or at least postpone it until later in the fall.

An Incident in British Municipal Ownership.

The Newcastle-on-Tyne Electric Supply Company was organized several years ago for the distribution of power in the vicinity of Newcastle-on-Tyne. The company was debarred from supplying current to Newcastle owing to the existence there of a municipal plant, but it has had a remarkably successful career, notwithstanding this handicap. On the other hand, the municipal Tynemouth station has been uniformly unsuccessful from a financial standpoint, and recently the authorities were faced with the necessity of adding additional plant, which, while adding to the investment, would carry with it no corresponding increase in revenue. As a result of this situation, the municipality has just made a contract with the supply company for 1¼ million kilowatt-hours annually of electrical energy at a price less than one-half what it costs the municipal plant to generate its present output. The supply company is also given the right to supply large power consumers within the area of the corporation municipal supply district from sub-stations, the municipality to collect the accounts and retain 5 per cent commission.

Ethics of Engineering Commissions.

In connection with Dr. S. S. Wheeler's fine presidential address before the American Institute of Electrical Engineers on the professional ethics of engineers, the following passage may be quoted from an address by Dr. Rossiter W. Raymond to the graduating class of Lehigh University: "Perhaps the commonest question of casuistry occurring in modern business is that of commissions. As the agent of your employers you have to purchase a steam engine. After getting the prices and inspecting the engines of all the manufacturers you decide upon the machine most suitable, on the whole, for your purpose, and in all legitimate ways beat down the sellers thereof to their lowest price. Just as you are about to close the bargain at the price they say: 'This covers, of course, your commission of 10 per cent.' When you reply that you do not expect any commission and suggest that, instead of paying it to you, they take it from the amount of the bill they send to your employers they tell you that according to some trade agreement they cannot charge a lower price, but can pay a commission to the selling agent. Now, you are not the selling agent, but the purchasing agent, and, explaining this difference to them, you tell them that you will be in honor obliged to pay your employers whatever commission may be paid you. To this they reply, with a kindly but cynical smile, that they do not care what you do with the money after you have got it, and you see clearly that they regard your protestations of honor as part of the formula which precedes your acceptance of the money. They do not really believe that you will not keep it if you get it. I am repeating an episode of my own experience, and perhaps my solution may be of use to you. I declined the commission offered in currency; required it to be put in the form of a check to my order; indorsed that check to the order of my employers and presented it to them, leaving them, if they saw fit, to return it to me as a legitimate perquisite of my position. They did not see fit, and they were quite right. But the most important feature in my action was that the return of the check, thus indorsed by me in their favor, convinced the manufacturers of my honesty as no amount of high toned oratory on my part could have done."

Convention of Canadian Electrical Association.

The Canadian Electrical Association last week had the unusual and novel experience of holding its meeting in the United States. This gathering was the 16th annual event in the history of the association, and it was held at the Cataract-International Hotel, Niagara Falls, N. Y. Owing to the failure to complete the new Clifton House at Canadian Niagara in time for the meeting, the association was forced to meet on the New York side or abandon the pleasure of a trip to Niagara.

The first session of the convention was held Tuesday afternoon in the large old dining room of the Cataract House, President A. A. Wright presiding. Addresses of welcome were made by both Mayor R. P. Slater, of Niagara Falls, Ont., and Mayor O. W. Cutler, of Niagara Falls, N. Y. The official heads of both cities at the Falls agreed that there had been unnecessary alarm created about the Falls of Niagara being destroyed. The electrical engineers were told that their profession was to blame for much of what had been accomplished in the development of power, and they were asked to study the falls carefully and learn for themselves that Niagara is as beautiful as ever. "Tell folks that the Falls are not going to be destroyed," said Mayor Slater, "in our time, or in the lives of our children, but even should they ultimately be lessened in volume, think of the tons of coal and the hours of labor they would save."

After responding briefly to the remarks of the mayors, President Wright delivered his annual address. He drew attention to the action of the Dominion government in sending a number of able and competent gentlemen to Europe to investigate the best methods practiced there for smelting certain grades of ores by electricity. On their return a sufficient sum of money was placed at their disposal by the government to establish an experimental smelting works at Sault Ste. Marie, and the results of these experiments have surpassed the most sanguine expectations. The following are the results as reported by Dr. Maanel himself: First, magnetite can be economically smelted by the electro-thermic process as hematite. Second, ores of high sulphur content not containing manganese can be made into pig iron containing a few thousandths of a per cent of sulphur. Third, the silicon content can be varied as required for the class of pig to be produced. Fourth, charcoal, which can be cheaply produced, from mill refuse or wood, which could not be otherwise utilized, can be substituted for coke as a reducing agent without being briquetted with the ore. Fifth, a ferro-nickel pig can be produced, practically free from sulphur and of fine quality, from wasted nickeliferous pyrrhotite. Sixth, the experiment made with titaniferous iron ore containing 17.82 per cent of titanic acid permits the conclusion that titaniferous iron ores up to perhaps five per cent titanic acid can be successfully treated by the electric process.

President Wright also referred to the bill of the Dominion government for the purpose of controlling the exportation of electrical energy to the United States. No action other than introducing the bill has been taken, and further proceedings have been stayed pending a conference with the Ontario government with the view of having the two governments act in harmony in whatever action they may deem it advisable to take. "Until some real understanding has been arrived at, it will be impossible for us to discuss this matter intelligently, not knowing what the bill may provide for when it is finally completed and passed the House of Commons."

Reference was also made to the radical departure which the Ontario government has taken in appointing what is called "Hydro-Electric Power Commission," which consists of three members whose duties it will be to carry out the government's policy of supplying municipalities with cheap electric power through assisting municipalities interested in acquiring and developing water powers for the purpose of generating electricity for light, heat and power purposes; and to the probability of the Ontario government running the trains on the Temascing Railway by electricity.

The report of Secretary-Treasurer G. H. Mortimer, of Toronto, Ont., showed the amount of cash on hand to be $1,131.47, an increase over the amount on hand a year ago. The number of

active members was given as 238, and the number of associate members as 152, making a total of 390. The report closed with this statement: "With the presentation of this, my fifteenth annual report, I beg respectfully to tender my resignation as secretary of the association. This step has been rendered necessary by the demands of my business. I have watched with pleasure the growth of the association from a membership of 25 to a membership of 390. Its position is now assured, and under the guidance of the many bright minds who have its welfare at heart, it will certainly go on to greater accomplishments in the future, keeping step with the wonderful developments of the science it represents."

The first paper read was by V. G. Converse, the subject being, "The Engineering Features of the Plant of the Ontario Power Company." A series of views exhibited by a stereopticon served to explain the paper, which was briefly discussed at the close of Mr. Converse's remarks.

In order that the business before the convention might progress as rapidly as possible, an evening session was held on Tuesday, at which time Mr. F. O. Blackwell read a paper on "Engineering Features of the Plant of the Electrical Development Company of Ontario, Ltd." The same evening Mr. H. W. Buck's paper on "Engineering Features of the Canadian Niagara Power Company's Plant," was heard. Considering the magnitude of the development of the three Canadian companies, it is hardly necessary to record that the members of the association were highly pleased with all the papers treating of the great Niagara power plants.

Attorney Robert McKay, of Toronto, Ont., read a paper on "Legal Points of Interest to Electrical Engineers." Of course, the paper was founded on Canadian law and decisions handed down by Canadian courts, for it is in the Dominion that the association has its interests. It was clear that Mr. McKay had made a very careful study of the laws bearing upon the electrical interests of his country, and the association knew its good fortune in having him meet with them.

Wednesday afternoon the convention went sightseeing. Invitations had been extended to visit the power plants on the Canadian side of the river, and the afternoon was spent in viewing the industrial wonders that have been established in Victoria Park. In the plant of the Ontario Power Company they looked upon the four big generators operated by twin turbines direct connected on horizontal shafts. In the plant of the Canadian Niagara Power Company they saw the generators operated on vertical shafts, and at the works of the Electrical Development Company, of Ontario, Ltd., they paid a visit to the big tunnel that has been driven from the wheel-pit under the river bed to the face of the grand old Horseshoe. The afternoon was replete with pleasure, and each member that made the trip to the Canadian plants has taken back home with him a very good idea of the immensity of Canadian Niagara and its power works.

Mr. John T. Farmer, of Montreal, read a paper on "Steam Plant Accessories" at the session Thursday morning. The executive committee will decide on the place of next meeting, but Montreal was suggested to the committee. The executive committee will name a supervisor of the "Question Box," but the wish of the convention was that Mr. A. A. Dion be continued in charge. Thanks were extended to the power companies that had assisted in making the convention pleasant, as well as to the retiring secretary, Mr. C. H. Mortimer, of Toronto. The election of officers resulted as follows: President, Mr. R. G. Black, Toronto, Ont; first vice-president, Mr. R. S. Kelsch, Montreal, Que.; second vice-president, Mr. W. R. Ryerson, Niagara Falls, Ont.; secretary-treasurer, Mr. T. S. Young, Toronto, Ont.; executive committee, Messrs. James Roberston, Montreal, Que.; A. A. Dion, Ottawa, Ont.; B. F. Reesor, Lindsay, Ont.; Charles P. Hunt, London, Ont.; Louis W. Pratt, Brantford, Ont.; J. J. Wright, Toronto, Ont.; W. Williams, Sarnia, Ont.; Lewis Burran, Quebec; H. O. Fisk, Peterboro, Ont.; J. W. Purcell, Walkerville, Ont.

Among the exhibitors at the convention were the Allis-Chalmers-Bullock, Ltd., of Montreal; the Pittsburgh Transformer Company; the Oneida Community, Ltd.; the Canadian Westinghouse Company. The Canadian General Electric Company was largely represented.

Convention of Railway Telegraph Superintendents.

The twenty-fifth, or "silver" anniversary, convention of the Association of Railway Telegraph Superintendents was held in Denver, Col., June 20 and 21. City Attorney Lindsley, of Denver, in the absence of the mayor, gave a warm welcome to the members of the association and the address was responded to by Secretary Drew.

After the election of several new active and associate members, Mr. Charles Selden, of the Baltimore & Ohio Railroad Company, opened the business of the convention by reading a paper on train order rules, which was discussed.

Mr. U. J. Fry, of Milwaukee, sent a communication to the convention on the subject of "Composite Circuits." In it Mr. Fry stated that the new instruments for this class of service furnished by the American Telephone & Telegraph Company were giving excellent results. In the discussion on this subject Mr. R. L. Logan, of Kansas City, Mo., referred to the value of portable telephone apparatus at "blind sidings." The "howler" type of apparatus, he said, appeared to give the best results, the instruments apparently never getting out of adjustment. Mr. F. H. Van Etten, of Chicago, also spoke favorably of the "howler" apparatus for composite circuits.

Mr. W. J. Camp, of Montreal, stated that he was at present conducting experiments on the lines of the Canadian Pacific Railway with the old style of American Telephone & Telegraph composite instruments and with telegraphone apparatus manufactured at Rochester, N. Y., and stated that he would communicate the results of his investigations to the association at a later date.

Mr. F. F. Fowle, of the American Telephone & Telegraph Company, spoke of the advantages of the new "howler" type of instrument, which he said was efficient, judging from a commercial standpoint. Mr. W. F. Williams, of the Seaboard Air Line, stated that he had several sets of this form of apparatus on his lines and all were giving excellent satisfaction. Some sets were used as often as from 30 to 40 times a day, and the few dry cells necessary to operate the composite service were renewed about every three months. Mr. B. A. Kaiser, of the American Telephone & Telegraph Company, of New York, called attention to the fact that his company had an experimental composite circuit in the convention hall over 100 miles in length, along one of the railroads, for the purpose of demonstrating the efficiency of the latest type of composite apparatus. Mr. E. P. Griffith, of the Erie Railroad, stated that many composite circuits on the Erie Railroad lines had worked successfully for over two years, the longest thus equipped being 82 miles in length.

In the afternoon Mr. W. W. Ryder, of the Burlington system, read a paper on "Increasing Railway Telegraph Facilities." He dealt with the question of economy of arranging the telegraph systems for a large railway and illustrated his points by means of a large map which he had prepared especially for the occasion.

Mr. F. F. Fowle discussed the question of "The Traffic of Railway Communications," showing the method of determining the facilities required for telegraph and telephone communication by the big railway systems. Mr. G. A. Cellar, of the Pennsylvania Railroad, Pittsburg, criticised Mr. Fowle's deductions and gave his experience in dealing with this class of work.

Referring to the subject of composite circuits, Mr. W. B. Glardon, of the National Telegraphone Company, Rochester, N. Y., stated that composite circuits have been expected by many to render as good service as metallic circuits. This was impossible. He referred to the number of telegraphones now in use on various railroads. This statement was evoked in reply to a statement made by Mr. H. C. Hope, of St. Paul, that he had not obtained satisfactory results in the operation of composite circuits. Mr. Hope also stated that his experience convinced him that composite apparatus would not work on circuits composed partially of underground wires or cables.

On the second day, after an executive session, Mr. John L. Davis, of Chicago, addressed the convention on the desirability of formulating uniform rules and regulations governing telegraph departments of railroads. He suggested the appointment of a

committee to investigate the matter and report the results to the American Railway Association for its approval. The suggestion was adopted and a committee will be appointed later on to take the matter up.

In the discussion of the subject of pole line construction it was pointed out that formerly 28 to 35 poles to the mile were considered sufficient, but modern construction calls for from 40 to 50 poles, with the result that a more efficient and permanent service is secured.

Mr. E. Parsons, of the Illinois Central Railroad, read a paper on overhead crossings. In the discussion attention was called to the valuable legislative work in the United States and Canada governing the crossing of railroads by foreign telephone, electric light and power wires.

The election of officers resulted as follows: President, E. A. Chenery, of the Missouri Pacific Railway System, St. Louis, Mo.; vice-president, E. P. Griffith, of the Erie Railroad, New York; secretary and treasurer, P. W. Drew, of the Wisconsin Central Railway, Milwaukee, Wis. Atlantic City, N. J., was chosen as the place for the next meeting, which will be held June 19, 1907. After a vote of thanks for the courtesies extended to the members by the railroad, telephone and telegraph companies, the convention adjourned.

A brief account of the exhibits of apparatus in connection with the convention is given below.

The Western Electric Company showed composite and private line telephone apparatus, Mr. W. E. Harkness, of Chicago, being in charge. Samples of the latest railway composite telephones and of the wall, desk and portable "howler" types were shown in practical operation upon a quadruplex circuit between Denver and McCook, a distance of 225 miles.

The Gill telegraph selector, manufactured by the United States Electric Company, New York, was represented by Mr. Edwin R. Gill, who is the inventor of the device.

The American Telephone & Telegraph Company was represented by R. E. Putrick and B. A. Kaiser, of New York; F. F. Fowle and E. G. Francis, of Chicago; N. R. Fill, of St. Louis; George L. Pavy, of Milwaukee; F. A. Morley, Los Angeles; V. B. Minturn, of Kansas City, and John R. McDonald, of Omaha.

Mr. W. S. Burnett, of the Morse Code Signal Company, of Milwaukee, exhibited his signal system in practical operation.

Mr. George W. Conkling, general manager of the Delany Telegraphic Transmitter Company, showed novel devices for the purpose of improving automatically dot-making in telegraphy and affording relief to the transmitting operator.

The National Telegraphone Company, of Rochester, N. Y., had an exhibit of its latest type of composite instruments and its portable "howler" for use in connection with composite telephone sets. Samples of its standard condenser and loud transmitter were also shown. The exhibit was in charge of Mr. W. B. Glandon, assistant general manager and engineer of the company.

The North Electric Company, of Cleveland, showed a line of its magneto telephone equipment, switchboard equipment and linemen's portable compact test sets. Complete magneto switchboards for small exchanges were also shown. The exhibit was in charge of Mr. J. G. Mitchell.

The Sandwich Electric Company, of Sandwich, Ill., exhibited sets of the Sandwich telegraphone. This is a device which provides for a talking circuit on an ordinary telegraph line without interfering with the operation of the Morse telegraph circuit, the two operations being carried on simultaneously.

Messrs. J. H. Bunnell & Co., of New York, distributed an artistically illustrated brochure of the City of Denver, which was eagerly sought by the members and preserved as a souvenir of the convention.

The Railroad Supply Company, of Chicago, was represented by Mr. E. W. Vogel, the company's signal engineer, and by Mr. F. C. Webb, its Denver representative. An exhibit was made of the company's new lightning arrester, which is now being put on the market in two styles, namely, mounted on slate base in one or more units, and an enclosed pattern for outside use. These lightning arresters are built on the choke coil principle. All parts are made extra heavy and are especially designed for railroad lines.

CURRENT NEWS AND NOTES.

GUAM-JAPAN CABLE.—On June 26 cordial greetings were exchanged between President Roosevelt and Mutsuhito, the Emperor of Japan, over the American cable connecting the Island of Guam and Japan, which was recently completed. The President's message, expressing the good-will of the American people and himself, was sent the day before and the Emperor's reply reached Washington on Tuesday. The line is part of the Commercial Cable network in the Pacific.

"THIRD RAIL EYE" is the Boston name for a "complaint" known in New York ever since the elevated roads went into operation. The Boston Elevated Railway Company, by reason of a decision of the Supreme Court rendered this week, may find itself open to local suits arising out of injuries which have been known as "the third rail eye." It has been asserted that many persons have suffered injury to their sight in consequence of particles of metal falling from the elevated structure. In the case before the court the plaintiff got a verdict of $2,000, which the court reduced to $1,000. The defendant filed exceptions, which were overruled by the Supreme Court.

TELEPHONE CONVENTION.—The National Interstate Telephone Convention began at the Auditorium Hotel, Chicago, on June 26. President J. B. Hoge, of Cleveland, said in his address that competition was the only way to reduce telephone rates. "The public never can get reduced rates for telephone service in Chicago or any other city," continued Mr. Hoge, "until there is a competing company. Eleven years ago there were but 300,000 telephones in the United States. To-day there are 5,000,000, and the increase has been brought about by the independent telephone companies, who have 3,000,000 telephones. There are 7,000 operating independent companies and 12,000 exchanges."

ELECTRICITY IN AMERICA.—A book that partakes more of the nature of a report than a description of travel is: "From New York to New York by way of the St. Louis Exposition." It has just been issued by Messrs. J. Holzschuch, Gaston Roux and Andre Silva, whose combined efforts have resulted in a handsome square quarto of 712 pages, profusely illustrated with 800 engravings. The first and smaller part of the book comprises notes of travel as to New York, Chicago and other cities, in their technical aspects. At least two-thirds of the volume, however, is devoted to the electrical exhibits at St. Louis, and the data and views of the apparatus are very full and explicit. While written for foreign readers, there is much in the book of interest to Americans. A few copies—less than half a dozen—at the price of $7, are available at this office. Although in French, it is the first report obtainable in complete form on electrical exhibits at St. Louis in 1904.

AMERICAN INDIVIDUALISM.—The Municipal Ownership Commission of the National Civic Federation of the United States attended a conversazione given in their honor at the Natural History Museum, London, on June 26. Mr. M. E. Ingalls, chairman of the commission, in the course of an interview, said he noted as the most striking feature of British municipal government the number of men of first rate capacity and integrity who were willing to devote their time to civic affairs. Such men in the United States, he said, generally were engaged about their own affairs, and had no time for municipal work, and therefore municipal government in the United States was rarely as good as here. Mr. Ingalls further said that conditions in America were distinctly adverse to municipal ownership, adding: "It does not follow that because we find a system working well here we can immediately transplant it to America. Besides, we find instances, such as gas works, where private companies are doing public work with equal efficiency." Mr. Ingalls observed that it was very curious that monarchical England was tending so strongly toward Socialism, while republican America was still remarkably individualistic.

SMALL TEXTILE MOTORS.—A great increase in the use of small electric motors is noticeable in the textile factories of Plauen, Germany, reports United States Consul Hurst. Of the 2,004 shuttle lace machine establishments, nearly half are driven by electric power.

SIOUX CITY GARBAGE.—A plan is under discussion to utilize the garbage of Sioux City, Ia., to make "denatured alcohol, this in turn driving engines for operating the electric light plant of the municipal building and the public library. The potato peelings and biscuits, chicken bones and apple cores, old rags and cherry seeds will all be boiled up together and converted into power for thousands of electric lights."

SUBMARINE SIGNAL INSTALLATIONS.—The Mersey docks and harbor board, which controls the docks and the approaches to the port of Liverpool, is equipping all four of its pilot boats and both its lighthouse tenders with the submarine signal. The French lighthouse board has authorized the equipment of one of their tenders, and the installation of a submarine bell on the lightship at Sandettie. Steamers making the port of Halifax now get submarine signals from the station at the southwest entrance to that harbor. The equipment of this station consists of two bells.

TELEPHONES IN CHURCH are becoming quite a matter of every-day fact. The latest instance is in Chicago. For the convenience of persons with impaired hearing twelve telephones have been installed in the First Methodist Episcopal Church. Dr. J. P. Brushingham, who for many years has been pastor of the church, believes that this will add to the attendance at the church and take away from many who now plead deafness as their excuse for remaining away from worship their reason for not attending. The telephone receiver will be connected with a large transmitting disk on the pulpit.

SILICON AS A THERMO-ELECTRIC ELEMENT.—In a patent issued June 19 to Mr. H. E. Heath it is stated that silicon may be employed as one element of a thermo-electric couple, and that when thus employed it possesses the advantageous feature of being highly refractory, and thus capable of withstanding high temperature. The silicon member is cast into the form of a rod, and is associated with copper, nickel or the like, as the other member of the couple, the nickel or copper in the form of wire being wound tightly about one end of the silicon rod. It is stated that with a rise in temperature of about 600° Centigrade the e.m.f. of this couple amounts to about .25 volt.

A TELEPHONE DIRECTORY.—What the modern telephone directory means in a large city is not realized by many people. The employes of the New York Telephone Company began the work of delivering the new summer telephone books and collecting the old ones last week. About 200 men are employed for this task, which takes about four weeks to complete, and means the handling of about 800 tons of paper. The new directory contains the names of over a quarter of a million of business houses and individuals. Three hundred and sixty-five thousand books will be distributed. The company has recently issued a very interesting pamphlet that contains all its literature, advertising, etc., in the recent struggle against "duplication" by the admission of one or more competing systems.

FRANCHISES IN WASHINGTON.—Senator Housbrough, has given notice of amendment to the bill making certain changes to street railway tracks in Washington, which will provide that every railway company now authorized by law, or which may hereafter be authorized by law, to operate cars on any of the streets, avenues or highways of the District of Columbia, and all other public service corporations of the District, including the Chesapeake & Potomac Telephone Co., Potomac Electric Lighting & Power Co., the Washington Gaslight Co. and the Georgetown Gaslight Co., shall annually pay to the collector of taxes of the District of Columbia, as a franchise tax, in addition to the taxes now imposed upon them by law, an amount equal to twelve per centum of their respective net earnings.

CIVIC FEDERATION INQUIRY.—A special cable dispatch from London of June 23 says: "The Public Ownership Commission of the National Civic Federation of the United States will conclude a month's investigation of municipal ownership in Great Britain June 30. They have visited all the cities where municipal ownership has developed, and have had every facility placed at their disposal. In some cases the commissioners have examined privately-owned concerns, such as the Norwich street railroads, which they went over to-day. On Monday they will visit the works of the South Metropolitan Gas Company, and the greater part of next week will be spent in London and its vicinity, the programme including, however, a side trip to Bristol. The commissioners have also been invited to attend the sessions of the Institute of Engineers and will lunch with the Lord Mayor, Walter Vaughan Morgan, June 27. As London is inaugurating immense municipal undertakings, principally electric street railroads necessitating generating stations which will be the largest in the world, the American visitors will have their time in the metropolis fully occupied."

ELECTRIC TERMINALS IN NEW YORK.—There has been an idea prevalent that in adopting single-phase traction the New York, New Haven & Hartford Railroad proposed to use the Pennsylvania terminal on Manhattan Island rather than the Grand Central depot. Plans for improving the local terminal facilities of the railroad were laid before the Rapid Transit Commission last week. The railroad applied for a franchise to extend its present four-track system from Woodlawn, approximately 240th Street, to a point near West Farms, so that connection can be made with the line of the Harlem River & Port Chester Railroad, a subsidiary company. By this connection the railroad, when the line is finished, can stop running trains over New York Central tracks from Woodlawn into Grand Central Station, and can instead run over the new extension and then the Port Chester tracks into the Port Morris yards at 129th Street. As the New York Connecting Railroad, when built, will run into the Port Morris yards also, the New Haven trains can be run over that line into the Sunnyside yards in Long Island City, and thence through the Pennsylvania tunnel under the East River and into the Pennsylvania terminal now being constructed between Seventh and Ninth Avenues, Thirty-first and Thirty-third Streets. This is taken to mean that the New Haven road plans to use the Pennsylvania station instead of the Grand Central Station. The Pennsylvania Railroad and the New York, New Haven & Hartford Road jointly own the New York Connecting Railroad, and have close traffic alliances.

COOLING NEW YORK SUBWAY is one of the things now most interesting to Manhattanites. An ammonia refrigerating plant is to be put in the Subway at Times Square. Chief Engineer Rice, in a report to the Rapid Transit Commission last week, said that the Interborough had offered to install and pay for the air-cooling apparatus. The plant will be installed in the sub-subway, that is, beneath the trains. The sub-subway is to be ventilated to the street, so that the ammonia fumes may pass directly to the outside air. There are to be brine tanks and mains to distribute the cold brine to the proper points in the Times Square and Grand Central stations. The chief engineer, after describing the plan, recommended such refrigeration for temporary use, but he said there was too much danger of leakage of anhydrous ammonia to permit of permanent, wholesale refrigeration. Mr. Rice also told of plans for cooling the air at Brooklyn Bridge and Fourteenth Street. He wants to dig four wells into the earth beneath the Bridge station and get ground water and then carry this water in pipes through the station. The cooling and ventilating plant must have four fans with a combined capacity of 150,000 cu. ft. of air a minute, two pipe coolers with surfaces to cool 150,000 cu. ft. of air a minute, and air ducts to distribute the cool air over the platforms. Mr. Rice wants to try an experiment in cooling the Fourteenth Street station in another way, as ground water cannot be obtained there. The details of his plan were not given. The cost of the Brooklyn Bridge and Fourteenth Street experiments will be about $75,000, and the Interborough's refrigerating plant will cost $45,000.

COLORADO ELECTRIC LIGHT, POWER AND RAILWAY ASSOCIATION.—The next convention of the Colorado Electric Light, Power and Railway Association will be held at Denver, September 18, 19 and 20, 1906. The programme is now under preparation and will be announced later.

POWER FOR MEMPHIS, TENN.—An act before Congress provides for the construction of locks and dams in the White River in Arkansas. If this permission is obtained it will involve the expenditure of $1,000,000 for transmitting electrical power for commercial purposes to Memphis. Local capital is interested. The transmission would be about a hundred miles.

STATISTICS OF CITIES.—The Bureau of the Census has just published Bulletin 45 giving statistics of 369 cities with a population of from 8,000 to 25,000 each. In these cities there are 189 waterworks owned by the municipality. Only 8 own gas works and 59 own the electric light plants. There were no regular firemen in 63, and in 41 the dependence was entirely on volunteer fire brigades.

LAMPS SMASHED BY HAIL.—A somewhat unusual occurrence was the destruction of large numbers of decorative incandescent lamps by hail at Coney Island during a severe storm on June 23. The hailstones were large and the explosion of the lamps at Luna Park, Dreamland and other places on the electric towers and exposed points made a loud noise heard distinctly above the roar of the storm.

WILL RUN HIS OWN PLANT.—The municipal plant at Tarentum, Pa., makes a minimum charge of $1 per lamp, regardless of the amount of energy consumed. One man whose two bills amounted actually to $1.20 has been charged the $2—"a high-handed robbery of 80 cents," says the local paper, which also states that "this man will put in a dynamo and soon produce his own light." It is a pity every worm does not turn in this courageous manner and install an isolated plant. These haughty managers of private corporations and municipal plants would soon be brought to terms.

ORANGE MOUNTAIN ACCIDENT.—A runaway trolley car on the Orange Mountain Traction Company's line, New Jersey, killed one man outright and injured a dozen more on June 24. The road is an extraordinary steep grade and was formerly cabled. Lately it was decided to adopt electricity with special brakes, employing a tongue that is let down on the surface of the track under the front wheels, blocking the wheels and applying friction directly to the rail. This first car out was going up the hill testing the emergency brake, but broke away backward near the top in some still unexplained manner. The inventor of the brake was among the injured.

WIRES IN SAN FRANCISCO.—Chief W. R. Hewitt, of the Department of Electricity, has reported on the work done in San Francisco for the fire and police departments since the fire. The estimated loss to the department is put by him at $177,400, including the central office at City Hall, $40,0000; damage to underground system, $40,000; damage to overhead construction, $35,000; engine house electrical equipment $18,500; fire-boxes, $16,600; police boxes, $15,000; sub-central office, $7,500; police station equipment, $4,800. Mr. Hewitt is to-day rapidly extending the signal system into the burned district, and keeping pace with all the reconstruction in the city.

JAPAN AND WIRELESS.—It is noted from Washington that Mr. Asano, an official of the bureau of communication of Japan, was there last week, and left to attend the conference on wireless telegraphy to be held in London. There is a large delegation from the Japanese government—several naval officers, some civilian employees of the navy department and a representative of the ministry of foreign affairs. The Japanese are among the most important delegates to the wireless conference, having had a great deal of practical experience with naval telegraphy during the Russo-Japanese war. Their views on the subject are awaited with great interest by the other delegates to the convention, and they will have much to say in the settlement of the international questions involved in the new method of communication.

A CAR'S WILD DASH.—According to a special cable dispatch from London of June 23, one of the municipal London trolley cars, filled with passengers, became uncontrollable while going down a hill near the Archway Tavern, Highgate, a spot congested by the traffic of several converging roads. After striking a hearse and other vehicles, the car crashed into a motor omnibus, which it lifted bodily and forced through the front of a store. The damaged car then bounded onward, smashing lamp-posts and narrowly escaping a collision with another street car. Of the passengers on the runway car and motor omnibus, three persons were killed, two others are not expected to recover, twenty were seriously hurt and many sustained slight injuries. It will be interesting to see whether the accident and legal charges get into their proper place in the "operating expenses" of the system.

CARBORUNDUM PRODUCTION.—Mr. J. H. Pratt reports for the U. S. Geological Survey on the production of abrasive materials in 1905. He states that the production of carborundum in 1905 amounted to 5,596,000 pounds, as compared with 7,060,380 pounds in 1904 and 4,759,890 pounds in 1903. There has been a general growth in the carborundum industry for abrasive purposes, and recently another use has been advocated for carborundum, namely, as a refractory material for furnace linings. As the most refractory variety of carborundum is infusible at 7,000°F. and is unaffected by oxygen, ozone, or sulphur at 3,000° F., its use as a refractory material should meet with success and should furnish a market for a considerable quantity of carborundum. The value of carborundum varies from 7 to 10 cents per pound. Mr. Pratt gives the production of alundum or artificial corundum at 3,612,000 pounds, valued at $252,840, an average of 7 cents per pound; as compared with 4,020,000 pounds in 1904.

TANTALUM MINERALS receive special attention in a report by Mr. J. H. Pratt for the U. S. Geological Survey, dealing with the rarer metals now employed in one form or the other for lighting. Three or four instances are cited of the occurrence of tantalum minerals in the United States. Some has recently been discovered at the feldspar quarry of Mr. W. F. Patterson, Jr., at Henryton, Carroll County, Md., about 28 miles from Baltimore. It occurs in irregular masses and rough crystals in the feldspar, and during the past year a considerable amount of this material was encountered in quarrying, but it was all thrown over the dump, as no one realized what the mineral was or its value. A specimen, however, was sent to the Westinghouse Electric Company at Pittsburg, and a partial analysis by its chemist gives 38.19 per cent of tantalic oxide and 13.21 per cent of niobic oxide. On account of the high atomic weight of the tantalum, the molecular ratio of the tantalic acid to the niobic acid is approximately 3.5 to 2. It may be that the material analyzed has a certain amount of feldspar mixed with the tantalum mineral, which would account for the high percentage of silica. Mr. Patterson will have the dump which has accumulated during the past year worked over for the tantalum mineral that has been thrown away, and all of this material henceforth obtained during the quarrying operations will be saved. Near Glastonbury, Conn., an old feldspar quarry is being investigated by Mr. Everett B. Hurlburt, of Glastonbury, as to the quantity of columbite or other tantalum mineral that may be found in this feldspar. Years ago when the quarry was worked for feldspar, there was more or less of this mineral found, but no attempt whatever was made to save it. Some material obtained from Tinton, S. Dak., was concentrated at Portland, Ore., and a heavy black mineral was obtained with cassiterite and scheelite as concentrates from the Wifley table, which, upon analysis, gave 44 per cent of tantalic oxide and 30.5 per cent of niobic oxide, these determinations having been made by Dr. W. F. Hillebrand, of the United States Geological Survey. The specific gravity of the mineral was determined to be 6.8. In 1904 there was a small production of columbite, one of the tantalum minerals, most of which was shipped abroad; and in 1905 the production was still smaller.

Bishop Creek, Cal., Hydro-Electric Power Plant.

BY J. D. GALLOWAY.

The hydro-electric power plant of the Nevada Power & Milling Co. is situated on Bishop Creek, Inyo County, Cal., about seven miles from the town of Bishop, and the transmission line extends to Goldfield and Tonopah in Nevada. The first generator was placed in operation in September, 1905, and since then power has been supplied the last-named places. The company owns the local lighting plants of the two cities and thus a portion of the load is the lighting circuits, while the balance is stamp mills and mines. While no unusual features are to be noted in the plant it is deemed of sufficient interest to warrant description.

Bishop Creek lies on the eastern slope of the Sierra Nevadas and, with the exception of Owens River, is the only considerable stream on that side of the mountains for several hundred miles. Its headwaters are in the snow of the highest part of the Sierras, which here reach an altitude of over 14,000 ft. above sea level. The plain of Bishop or the Owens River valley lies at an elevation of about 4,000 ft. The mountains rise abruptly from the plain, and the descent of the stream is correspondingly rapid. Its fall is over 1,000 ft. in two miles. This, so far as the writer knows, is the most favorable location in this respect of any power plant in the West.

Water is taken from the creek at a small diverting dam and conveyed along the mountainside in a wooden stave pipe until it reaches a point above the power house, where it enters a steel pipe that leads to the power house on the creek bank.

The transmission line extends across the valley of the Owens River, then over the White Mountain and across the Nevada Desert to Tonopah Junction, 85 miles. From here the line branches to Tonopah, 18 miles, and to Goldfield, 10 miles, making the total length of line 113 miles. In crossing the White Mountains the line reaches an elevation of over 10,500 ft.

The pipe line commences at the diverting dam, there being no flume. The dam is a small concrete structure supplied with four wasteways provided with flash-boards for regulating the height of water. At the present time the supply of water is ample at all seasons of the year, but with an increase of load

FIG. 1.—GENERAL VIEW OF PIPE LINE AND POWER HOUSE.

it is the intention to enlarge this small reservoir formed by the dam in order that it may act as a regulating reservoir. As the load factor on power plants of this description may vary from 0.7 to 1.0, an average being 0.8, a regulating reservoir at the end of the pipe lines becomes a necessity when using stored water.

Water enters the pipe line through an intake chamber at one side of the dam. A screen is placed at the entrance to this chamber, made of ¼x1½-in. flat iron bars, the vertical bars being placed 2 in. apart and the horizontal bars 1 in. apart.

FIG. 2.—GATES AT HEAD OF PIPE LINE.

Back of the screen are three timber gates operated vertically by rack and pinion. The wooden pipe enters the intake through the concrete wall, being built into it in place.

The pipe line is about 12,000 ft. long, consisting of 6,700 ft. of 42-in. wood-stave pipe, 2,150 ft. of 30-in. wood-stave pipe and 3,150 ft. of 24-in. steel pipe, all diameters being inside measurements. The 42-in. pipe lies on a nearly level grade, the static head at the lower end being about 30 ft. At this point are placed two 30-in. gate valves, one opening into the 30-in. pipe and the other provided for a future line. The 30-in. pipe descends the hill to a point that gives a static head of 265 ft. Here it joins the 24-in. steel pipe which descends a steep hill to the power house, the total static head being 1,068 ft. For about 500 ft. this steel pipe is laid on a slope at an angle of 38 degrees from the horizontal.

The 42-in. pipe is made up of twenty-five staves and the 30-in. pipe of nineteen staves, milled from a 2x6-in. piece. The lumber is red fir from Southern Oregon and the staves were milled there to the proper circle. The bands are of mild steel of circular section ½ in. in diameter with ends upset to ⅝ in. diameter. They were shipped straight and bent to form at the work. The lugs were of cast-iron of a form that allows the ends of the bands to pass each other and be tightened with nuts on each end. When the bands are tightened there is a slight bending of the rods, but this is not believed to be injurious. The ends of the staves were slotted and a 3/16x½-in. compressed paper dowel inserted. When wet this dowel swelled and was very effective in closing leaks.

Bands on the 42-in. pipe were spaced on 6-in. centers, although the pressure did not demand this close spacing. On the 30-in. pipe, which is subject to a considerable pressure, the writer used the pressure due to swelling of wood given by A. L. Adams, 100 lb. per square inch, but in addition to this an allowance was made for initial tension in the rods due to the stress necessary to bring the staves into form. The red fir is a very stiff wood, and by observation it was determined that it was necessary to use 2,100 lb. to bring the staves into position; this was calculated as being distributed along one lineal foot of pipe and distributed among whatever number of bands occurred in that length under different heads. Bands were spaced under these assumptions with a safety factor of four.

The question of initial tension on the rods is believed to be a vital one, as in the case of the stiff lumber used it required

much cinching to make the staves come together. As the wood is hard, the bands crush into it but little under pressure and hence there is little relief to the stress. By tests it was determined that, with the wrenches used, an initial tension of 8,000 lb. per square inch could be easily obtained.

The wood pipe is laid directly on the ground, a few sills of culled material being placed at intervals. At points it was covered with earth as a protection from possible rocks rolling down the steep hillsides. The pipe was laid in easy curves, but in one case a curve of 100 ft. radius was made through nearly 90 degrees. For nearly two months the daily amount laid averaged 110 ft.

The wood pipe is provided with two 6-in. and one 30-in. standpipes, the former being of casing and the latter of 30-in. wood pipe. In addition 6-in. air valves are supplied in such number that there is a 6-in. opening every 1,100 ft. On the steel pipe, three 6-in. air valves were placed at the upper end. The material for the wood pipe was mostly hauled to the site on wagons, a minor portion being hauled up from the power house on the tramway used in laying the steel pipe.

The steel pipe is 24 in. inside diameter, of lap welded steel and was furnished by the Pelton Water Wheel Co., agents for the makers, a German firm. It is in three thicknesses, ½, ⅜ and ½ in. The sections are 30 ft. long and the ends are male and female, swelled and of cone shape, so that an angle may be made

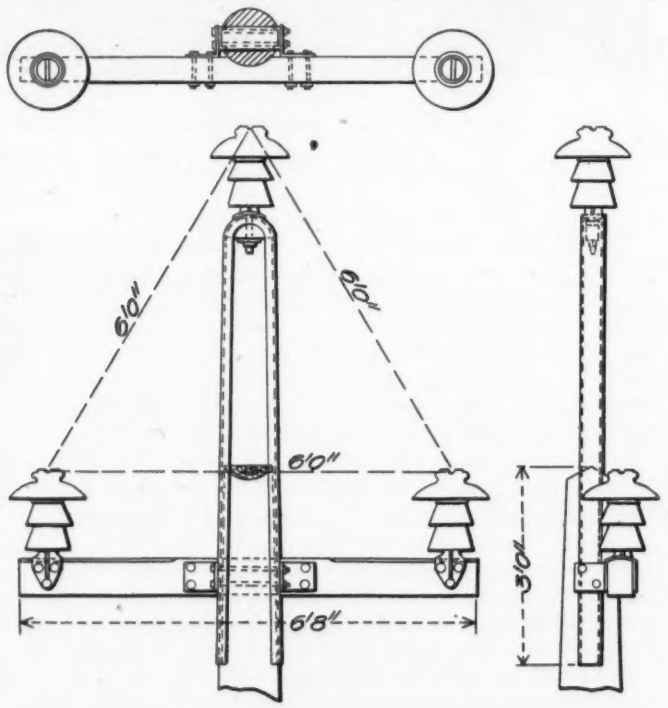


FIG. 3.—PLAN AND ELEVATIONS OF POLE TOPS.

between sections. The maximum angle turned was 2 deg. 30 min. between two joints. The joints were connected by a single line of rivets, the holes being drilled in the field. The pipe is anchored at intervals by a strap clamped around the pipe and rods, with turnbuckles fastened to bed rock.

The tramway for raising the pipe from the power house, where it was brought by wagons, was made of discarded narrow-gauge rails and ties laid alongside the pipe trench. The pipe sections were hoisted to place on a single car about 8 ft. long fitted with cables to fasten the joint to the car. The hoisting rope was a single ⅝-in. steel cable, and the hoisting was done by an electric hoist made by the Hendrie & Bolthoff Mfg. & Supply Co., of Denver. This hoist was provided with a friction drum of large size and was very effective in handling the loads. The length of the tramway was about 3,300 ft., and as there were several horizontal curves in the line, the cable was held in place by vertical grooved rollers. Rollers were also provided on the straight sections and no difficulty was had with the car returning to the foot of the hill by gravity. Loads of 5,000 lb. were easily handled.

For drilling and riveting purposes, a compressor operated by an electric motor was provided near the power house and an air-pipe line run to the top of the hill. This line was made

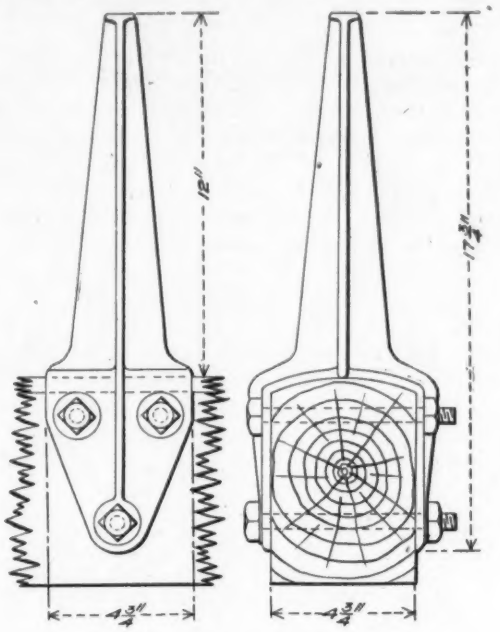


FIG. 4.—INSULATOR PINS.

of about 500 ft. each of 2-in. and 1½-in. pipe, the remainder being 1-in. This air pipe was provided with connections at intervals, and air drills and air hammers were used on all the work. In laying the pipe, the holes in the female end were drilled in the yard. The section was then taken up on the tramway, laid in place and the male end drilled, after which it was riveted without being disturbed. This gave very tight joints. Progress on this work was slow in the rock trench near the power house, but for a distance of 2,500 ft. the pipe was placed at the rate of 3⅔ joints laid, drilled and riveted per day. The steel pipe has been entirely covered.

The power house is a 32x82-ft. concrete building with a 23x52-ft. ell. The roof is of steel, covered with corrugated iron. The main section has a louvre for ventilation. Over the main section is placed a 10-ton, hand-operated traveling crane running on rails supported by reinforced concrete girders of 16 ft. span. The crane was made by the Cyclops Iron Works, of San Fran-

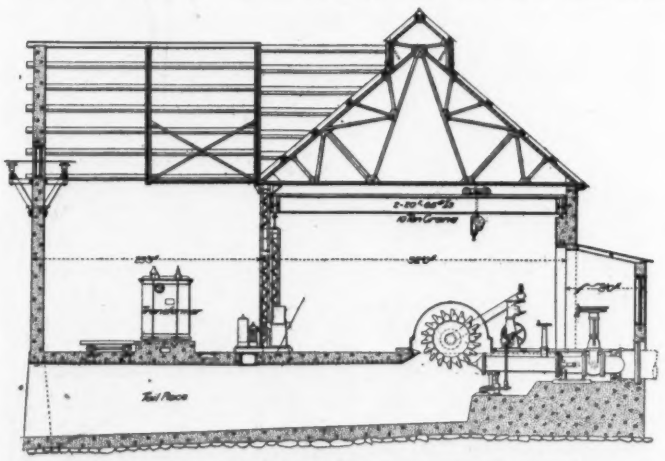


FIG. 5.—CROSS-SECTIONAL VIEW OF POWER HOUSE.

cisco. The building, together with the foundations of the machinery and the tail races, rests on a mass of large boulders, bed rock being unknown in the country.

The equipment of the station consists of two 750-kw, 60-cycle, 2,200-volt, three-phase alternating-current generators running at 450 r.p.m. They were made by the National Electric Co., of Milwaukee, the same firm supplying the exciters. In addition there is now being installed a 1,500-kw generator running at 400 r. p. m., supplied by the Allis-Chalmers Co. This gen-

erator is shown in the sectional drawing and the location of it and the other machines is shown on the plan. There are two exciters of 60 kw each, delivering current at 140 volts pressure. Both exciters are operated by waterwheels, and in addition, one is provided with an induction motor.

The water wheels for the entire plant were made by the Pelton Water Wheel Co., of San Francisco. The two 750-kw machines have Sturgess governors and the 1,500-kw machine has a type Q Lombard governor. Hand-control mechanism is provided for each wheel. Oil is supplied the governors by two oil pumps operated by water wheels. The generators are of the two-bearing type, the water wheel overhanging the tail race.

From the generators the leads are laid in trenches to the switchboard and transformers. The switchboard is provided with Westinghouse instruments. The transformers, of which there is one spare, are 500-kw, oil-insulated and water-cooled apparatus, as made by the Stanley-G. I. Co. They are placed on pedestals and rest on iron rollers by which they can be removed to a car for repairs.

The power lines pass the wall of the building through windows of 28-oz. glass in 36-in. square panes, there being two panes to each window, the outer one with a 6-in. opening and the inner one with a 4-in. opening. The line from the power house to Tonopah is of stranded aluminum equivalent to No. 0 copper. From Tonopah Junction to Goldfield the line is No. 2 aluminum stranded. The insulators are four-part porcelain, 14 in. in diameter held on malleable iron pins. The triangle of the wires is equilateral, with 72-in. sides, and the spans are normally 310 ft. On parts of the line near railroads, cedar poles from Oregon were used and in the mountains native timber. The poles were equipped with a steel channel at the top, bent and fastened to the pole with bolts. The channel supports the top insulator.

The building of this line was done under extreme difficulties, due to heat and absence of water on the desert. The cost of watering a horse amounted to 85 cents per day, and this can be appreciated when it is stated that if a four-horse team started on a day's haul, a similar team went along with the necessary water for the two.

A telephone line was built parallel to the power line, but on separate poles, and the wisdom of this has been shown this winter. The line is also practically free from the induction usually found where the telephone line is placed on the power line poles.

A switch station was built at Tonopah Junction and sub-station at Tonopah and Goldfield. They are of stone and each contains three oil-insulated, air-cooled Stanley transformers of 300 kw each. Current is reduced to a pressure of 6,600 volts for local distribution.

The line has been operated at a line pressure of 30,000 volts, but when the demand arises for more power, it will be operated at 50,000 volts by connecting the transformers in star.

The officers of the company are: F. J. Campbell, president; G. G. S. Wood, secretary, and C. M. Hobbs, general manager. The main office is at Denver, but the management of the construction was in the hands of Mr. C. M. Hobbs, at Tonopah and Bishop. Mr. C. O. Poole was consulting engineer on the entire installation of the first two units. R. M. Jones, in conjunction with Mr. Poole, designed and located the plant. The head dam, the pipe trench and a part of the wooden pipe were built under Mr. Jones' supervision. The construction of the remainder of the pipe, together with the building of the power house and the installation of the machinery, was carried out under the supervision of the writer, with Mason Galloway as assistant. The installation of the 1,500-kw generator and wheel is under the charge of the writer. The line construction was under the supervision of L. B. Curtis, with J. B. Balcomb and Charles G. Patrick as assistants. The operation of the power house is in charge of J. W. Todd, as superintendent.

Active work was commenced early in March, 1905, and current was turned on the line on September 17, since which time the plant has been in successful operation.

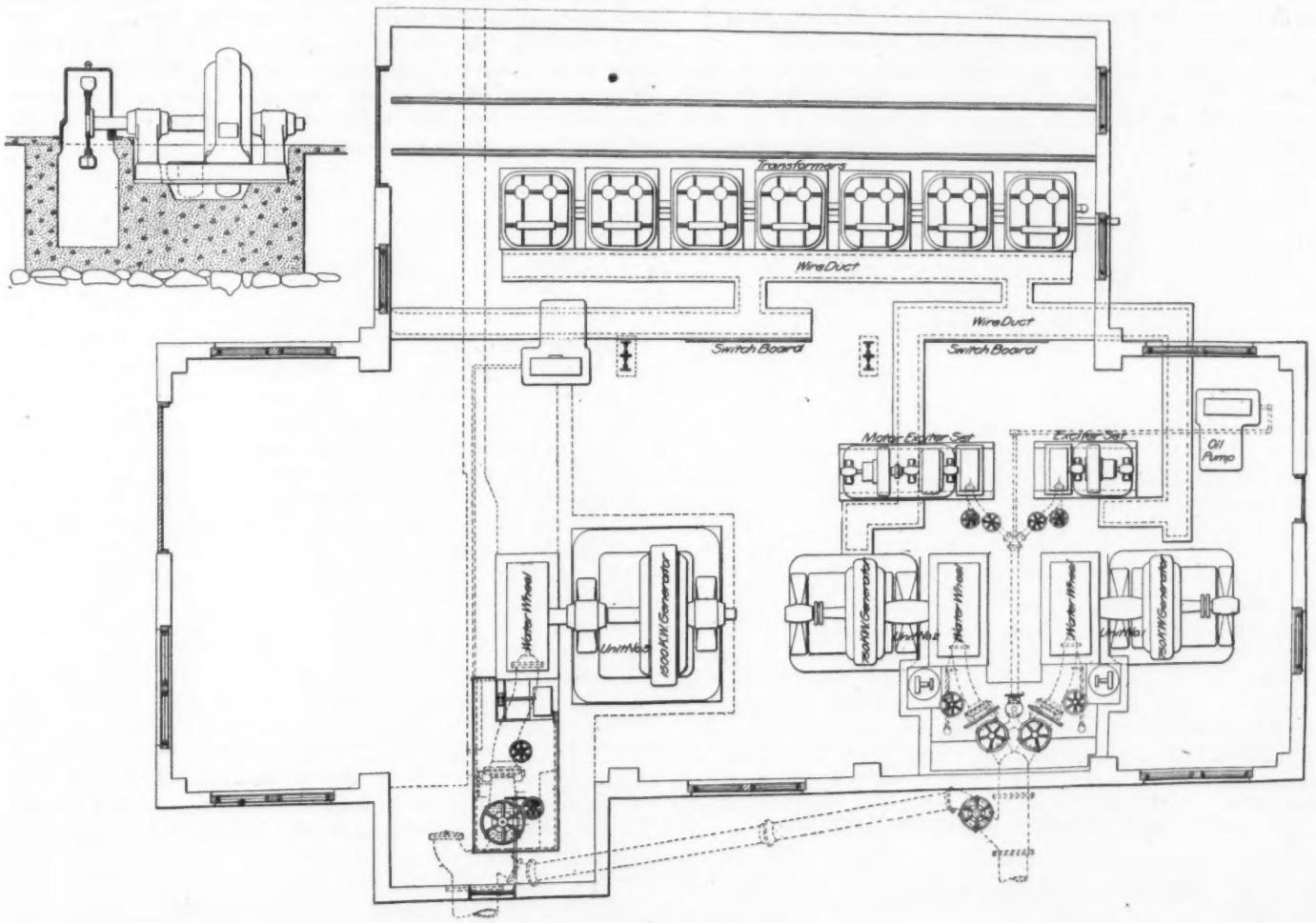


FIG. 6.—PLAN OF POWER HOUSE.

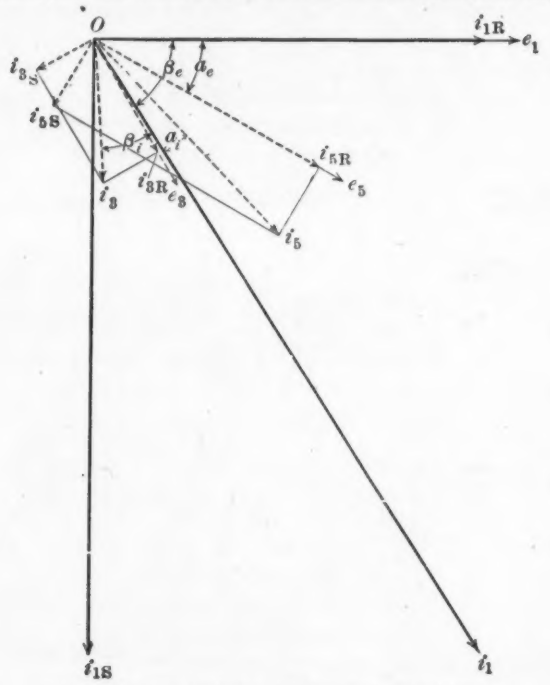
Graphical Treatment of Higher Harmonics.

By R. E. Hellmund.

IN the treatment of alternating-current problems it is customary to assume a sine shape for the e.m.f's and currents. There are cases, however, where the difference between the actually impressed wave form and the sine wave is so great that it is necessary to take the real wave form into consideration. In such cases the wave shape of the impressed e.m.f. must be analyzed into its higher harmonics, and the analytical derivation necessary to obtain the desired data, even in simple cases, are so complicated that it requires an enormous amount of time and perseverance to carry them through.

It is believed that the graphical method described below reduces the necessary work considerably. If an e.m.f. having a wave shape containing certain harmonics is impressed upon a pure non-inductive resistance, the current of each harmonic will be in phase with the potential of the same harmonic, and the value for each harmonic may be found separately.

When a similar non-sinusoidal e.m.f. wave is impressed upon a pure inductive reactance, the phase of the current of each harmonic lags 90 behind the phase of the potential of the same harmonic, and the value of the current of each harmonic may likewise be found separately. In this latter case, care must be taken to recognize the increased frequency of the higher harmonics.



GRAPHICAL TREATMENT OF HIGHER HARMONICS.

When a pure non-inductive resistance is connected in parallel with a pure inductive resistance, the resultant value of each harmonic is simply the geometrical sum of the value of the component currents. Therefore, each harmonic may be treated separately by graphic methods, as it is possible and customary with simple sine waves.

For the present case this has been done in the accompanying diagram. The vectors, e_1, e_3 and e_5 represent the amplitudes of the first, third and fifth harmonic of the impressed e.m.f. In phase with them are the non-inductive currents, i_{1r}, i_{3r} and i_{5r} In right angle with the e.m.f. are the inductive currents, i_{1s}, i_{3s} and i_{5s}. As resultant currents for the different harmonics are found the vectors, i_1, i_3 and i_5. It remains now only to read the values of the resultant currents from the assumed current scale. It is comparatively simple to determine from this figure the effective total current, since there are only three components; of course, the shape of the resultant current wave may be also easily derived, also the form factor, etc.

In order to avoid mistakes, it is preferable to use lines of different characteristics for the representation of the different harmonics, as has been done in the illustration, where the amplitudes of the first harmonics are indicated by full lines, those of the third harmonic by lines of long dashes, and those of the fifth harmonic by lines of short dashes. In cases where the amplitudes of the higher harmonics are small in comparison with those of the first harmonic, the scale for the higher harmonics may preferably be taken equal to a multiple of the scale for the first harmonic.

If circuits with capacity enter the problem, similar ways of proceeding may be employed; of course, the currents must be represented in the diagram by leading vectors.

Attention should be called to the fact that in the diagram no graphical addition of currents of different frequencies has been accomplished. All that has been done is a graphical addition of the components of each harmonic separately. It should be noted also that it is not correct to consider the various vectors as representing effective current values as is customary in graphical treatments of single harmonic functions. With sine functions this is admissible, since there is always the same relation between effective and maximum current values; this is, however, not true in case of harmonic waves which are made up of sine functions of different frequencies. It is instructive to recall that the effective value of superposed sinusoidal currents of different frequencies is the square root of the sum of the squares of the effective values of the component currents.

The Estimation of the Temperature Rise of Armatures.

By A. Press.

The methods in vogue of estimating the armature temperature rise give in many cases results differing from actuality as much as 300 per cent either way. Although this great discrepancy is not in many cases reached, the estimation of temperature rises has almost become a standard joke among engineers. As a usual thing no account is taken of sparking at the commutator in the estimation of temperature rises, and further, the relation between the watts per square inch wasted on the commutator per unit peripheral speed and the watts wasted on the armature per unit surface and peripheral speed seems to have been entirely overlooked.

It must appeal to every one that if the temperature rise on the commutator is high, and that on the armature is low, an appreciable amount of the commutator watts will be perforce radiated on the armature by virtue of the high thermal conductivity of the copper that connects the commutator lugs to the armature coil ends. By taking this latter effect into account in a theory of heat distribution, it is possible to estimate the permissible watts per square inch that can be wasted on the armature as a function of the ratio of possible temperature rises on the armature and commutator at certain peripheral speeds.

Let W_c = commutator watts,
C = commutator radiation constant,
W_a = armature watts,
A = armature radiation constant,
B = constant depending on the conductivity of copper,
S_n = available cross-section of coil leads,
T_c = commutator temperature rise,
T_a = armature temperature rise,
D = armature diameter,
D_c = commutator,
$1 + 2L$ = armature length of barrel surface; that is, including the axial length of the coil connections.
1_c = commutator face length,
R = revolutions per minute.

Inch units are used throughout.

Now it is obvious that what watts are not radiated from the commutator directly must be radiated by conduction from the armature surface. Expressing these facts analytically we have

$$W_c = C\pi^2 (D_c)^2 1_c R T_c + B S_n (T_c - T_a)$$
$$A\pi^2 D^2 1 R T_a = W_a + B S_n (T_c - T_a),$$

or
$$W_c = C\,T_c + B\,(T_c - T_a)$$
$$W_a = A\,T_a - B\,(T_c - T_a)$$

Solving these equations one obtains for $\frac{T_c}{T_a}$ the following:

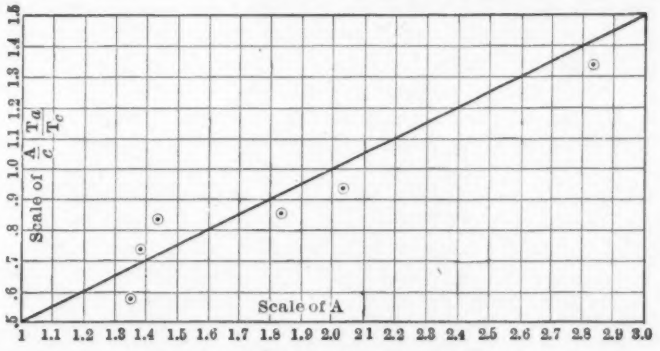
$$\frac{T_c}{T_a} = \frac{\frac{(A+B)}{(B+C)}\frac{W_c}{W_a} + \frac{B}{C+B}}{\frac{B}{(B+C)}\frac{W_c}{W_a} + 1}$$

and if B is small compared to A or C,

$$\frac{T_c}{T_a} = \frac{A}{C} \cdot \frac{\textit{Watts per unit of commutator surface per unit of peripheral speed}}{\textit{Watts per unit of armature surface per unit of peripheral speed}}.$$

or
$$\frac{A}{C} \cdot \frac{T_a}{T_c} = \frac{W_a}{W_c}\left(\frac{D_c}{D}\right)^2 \frac{\textit{Commutator face length}}{\textit{Armature over-all length}}.$$

If now the small exchange of heat units from commutator to armature really affect the final temperature rises, by plotting $\frac{A}{C} \cdot \frac{T_a}{T_c}$ *from its value* $\frac{W_a}{W_c}\left(\frac{D_c}{D}\right)\frac{1_c}{1+2L}$ against the armature watts lost divided by the barrel surface one should obtain consistent results. The accompanying illustration shows actual plotted points for six different machines taken at random.



TEST RESULTS FOR SIX ARMATURES.

The cases taken were those in which the machines showed no excessive sparking. The range of diameters was from 8 to 40 in. The disagreement in the worst case was 17 per cent, whereas calculated by the ordinary theory there would be at least 200 per cent discrepancy in the worst case. The observed commutator temperature rises were in all cases below the estimated value. The discrepancy is due to the quite radical differences possible in the lug ventilation.

It is to be noted that the iron loss and the brush friction loss were calculated in each case; the armature copper loss, the brush I^2R and the temperature rises were observed. The formula used is the following:

$$\frac{\textit{Armature losses}}{\textit{Barrel surface}} = K\,\frac{P_s}{1{,}000},$$

where P_s is the armature peripheral speed in feet per minute and where K is determined by the particular value of $\frac{A}{C} \cdot \frac{T_a}{T_c}$ calculated from $\frac{A}{C} \cdot \frac{T_a}{T_c} = \frac{W_a}{W_c}\left(\frac{D_c}{D}\right)^2 \frac{1_c}{1+2L}$.

By a happy coincidence it is seen from the figure that $\frac{A}{C} \cdot \frac{T_a}{T_c} \div A$ is equal to ½. Hence, it follows that the watts per sq. inch of armature surface may be expressed as $W_s = \frac{P_s}{500}\frac{A}{C}\frac{}{\frac{T_a}{T_c}}$ for 40° C.

The estimation of the commutator temperature rises cannot be reduced to the same finality as the armature temperature rises.

Simple Circle Diagram of the Single-Phase Induction Motor.

By A. S. McALLISTER.

AN article in the issue of the ELECTRICAL WORLD for May 26 gave a description of a simple circular locus of the primary and secondary currents of a polyphase induction motor for determining the complete performance of the machine. The present article shows the method by which a similar diagram may be used with a single-phase induction motor.

The chief difference between a single-phase and a polyphase induction motor resides in the character of the magnetic fields of the two machines. At synchronous speed each machine possesses a true revolving field. At standstill, however, while the magnetic field of the polyphase motor revolves synchronously and is of more or less constant strength, the field of the single-phase machine is unidirectional in space and alternating in value.

If, when the rotor of a polyphase motor is stationary, a circuit be opened so that current flows through only two leads of the machine, it will be found that the total volt-amperes taken by the machine decrease to about one-half of the former value, the power factor being practically unchanged. That the magnetomotive force of the current in each phase winding of a two-phase motor when the rotor is stationary produces a flux which (for constant reluctance of the core) acts as though the flux due to the current in the other winding were not present may be seen at once without proof. It will be appreciated, also, that the currents produced in the secondary by two alternating fluxes which are in electrical space quadrature do not interfere one with the other, so that the current in each primary winding flows just as though the other primary current did not exist. Thus the "equivalent single-phase" starting current of a two-phase motor is just twice that of the same motor when only one phase winding is used; the power factor is the same in the two cases. Both experimental and theoretical investigations show that the "equivalent single-phase" starting current of a three-phase motor is also equal to twice the current which flows through two leads when the third lead is interrupted.

If, when the rotor of a polyphase induction motor is revolving synchronously a primary circuit of the machine be opened, it will be found that the current flowing through the remaining leads increases and that the total volt-amperes taken by the machine remain practically constant, the power factor being practically unaltered. (The power component of the equivalent single-phase current increases to a small extent, while the wattless component decreases slightly.) The action of the machine at synchronous speed is attributable to the continued existence of a revolving magnetic field of practically constant strength which requires a definite component of current in phase with the voltage to supply the losses and another component in quadrature with the voltage to supply the "quadrature watts" for excitation. A subsequent article will explain the distribution of current in the secondary conductors, and will show in what manner the "quadrature watts" for the "speed field" are supplied by the primary exciting magnetomotive force.

When the rotor of a polyphase motor is revolving synchronously, the secondary current has a negligible value. In the

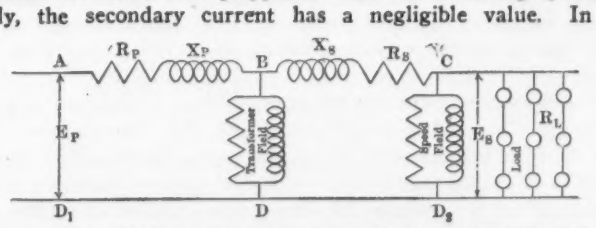


FIG. 1.—PRACTICALLY EXACT REPRESENTATION OF CIRCUITS OF A SINGLE-PHASE INDUCTION MOTOR.

single-phase motor, however, the secondary current at synchronous speed has a value such that its magnetomotive force produces in electrical space quadrature with the main alternating field through the primary coil, a field which is equal in value and in time quadrature with the main field. The value of the main field is determined by the primary e.m.f. just as is true in any transformer, while the field which is in quadrature both in time and in space therewith depends for its value both upon the

"transformer field" and upon the speed of the rotor; the two fields are equal in effective value at synchronous speed, and at other speeds the "speed field" is equal to the "transformer field" multiplied by the speed, synchronous speed being taken as unity. Thus the "speed-field" component of the secondary current varies with the speed and is zero at standstill.

The circuits of a single-phase induction motor can be represented with a fair degree of accuracy if the primary and secondary resistances and the leakage reactances be arranged as shown in Fig. 1, the "transformer field" and "speed field" exciting circuits being connected as indicated. The current taken by the load and that used to produce the "speed field" pass through both the primary and the secondary coils, while the current required for the "transformer field" flows through only the primary coil. When the load circuit is opened, that is, at synchronous speed, the "speed field" current and the "transformer field" current are practically equal in value. When the resistance of the load circuit is zero, that is, at standstill, the "speed field" current is zero, and the current which flows through the coils of the machine acts as though the "speed field" circuit were not present. It is to be noted especially that the decrease in the "speed field" current below the value of the "transformer field" current is attributable to the variation of the rotor speed from synchronism and not to the drop in voltage across the secondary winding, which is caused by the load current. The "secondary load" current flows in electrical space quadrature to the "speed field" current, and the two currents in no way interfere with each other. The statements just made relate exclusively to the current whose magnetomotive force produces the "speed field," which current, on account of its electrical space position, does not react in any way upon the "transformer field." The secondary carries also another component of current in addition to the load current. The time-phase position and the electrical space positions of this component are such that its magnetomotive

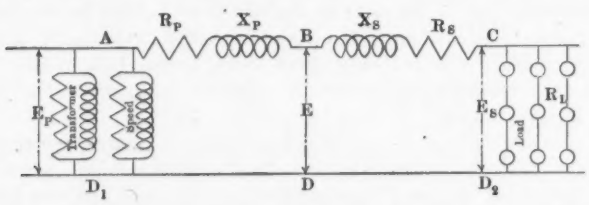


FIG. 2.—MODIFIED REPRESENTATION OF CIRCUITS OF A SINGLE-PHASE INDUCTION MOTOR.

force tends directly to decrease the "transformer field"; thus, it acts like a "wattless" secondary current. It is this latter component of secondary current which is represented in the circuit diagram of Fig. 1. This component bears to the actual "speed field" current (approximately) the ratio of the actual rotor speed to the synchronous speed. Thus the voltage impressed upon the "speed field" circuit of Fig. 1 is (approximately) equal to that impressed upon the "transformer field" circuit multiplied by the square of the speed, synchronism being taken as unity. These facts will be discussed more fully in a subsequent article.

Although it is possible to construct primary and secondary current loci based on the circuits shown in Fig. 1, the problem of dealing with the value and phase positions of the currents is greatly simplified without involving a detrimental loss of accuracy by using the modified arrangement of circuits indicated in Fig. 2.

The current diagram for the circuits shown in Fig. 2 is given in Fig. 3, where $M N$ is the power and $O N$ the wattless component of the primary current at synchronous no load, while $F I$ is the power component and $I M$ the wattless component of the primary current at standstill. The curve $O P F K$ is an arc of a circle having its center on the line $O N$ prolonged. $O L$ is the "speed field" current (assumed constant in the diagram, but properly accounted for in the computations). $L M$ is the "transformer field" current, while $O M$ is the total primary current at synchronism.

The line $F I$ drawn perpendicular to $M T I$ represents the total loss of the machine at standstill—the proper scale being used. $H I$ indicates the so-called "constant" losses, while $F H$ shows the sum of the "added" primary and secondary copper losses. If the distance $G H$ be laid off to represent accurately the easily determinable "added" primary copper loss, then $F G$ shows the "added" secondary copper loss. Straight lines being drawn to join the point F and the point G with O, of Fig. 3, if from any point P on the circular arc, $O P F K$, a perpendicular be dropped to the line $M I$ the following values may be taken at once from the diagram:

$O P$ is the "added" component of the primary current,
$O P$ is also the "added" component of the secondary current.
$P L$ is the total secondary current,
$P M$ is the total primary current
$Cos\ E M P$ is the power factor.
$P T \div P M$ is the power factor,
$S T$ is the "constant" losses of the machine,
$R S$ is the "added" primary copper loss,
$R T$ is the total primary losses (including "speed field" excitation current loss in secondary),
$Q R$ is the "added" secondary copper loss,
$Q T$ is the total losses of the machine,
$P T$ is the input to the machine,
$Q P$ is the output.
$Q P \div P T$ is the efficiency,
$P R$ is the total input to the secondary (excluding the "speed field" excitation current loss).
$(P Q \div P R)^{1/2}$ is the speed with synchronism as unity.
$(P Q \times P R)^{1/2}$ is the torque in synchronous watts.

The representation of each of the quantities listed above, with the exception of the speed and the torque, will be appreciated at once from a comparison of Fig. 2 with Fig. 3, combined with a review of the article in the issue for May 26.

The speed and the torque can be ascertained in an extremely simple manner as follows: The "speed field" is under any chosen condition equal to the "transformer field" multiplied by the speed. Now the torque is proportional to the product of the "speed field" and that component of the secondary current which is in time phase with it and which crosses the core at the same mechanical position along the air-gap as that occupied by the "speed field." This component of the secondary current is in time quadrature with the "transformer field," and it has a value

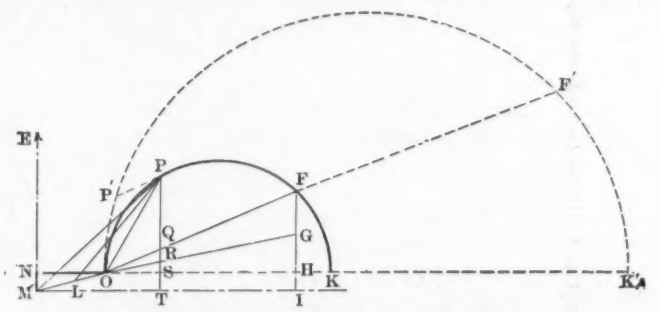


FIG. 3.—CURRENT LOCUS OF SINGLE-PHASE INDUCTION MOTOR.

such that its product with the primary e.m.f. (for a unity ratio machine) represents the total power received by the secondary—exclusive of the loss due to the secondary excitation current. A little study will show that if the "speed field" were equal to the "transformer field," the torque in "synchronous watts" would be equal to the secondary input (excluding the excitation loss). Since the "speed field" varies directly with the speed, it is seen at once that the torque, D, is equal to the secondary input, W_s, multiplied by the speed, S. Thus,

$$D = S W_s. \qquad (1)$$

The torque is also equal to the output W_o, divided by the speed; therefore,

$$D = W_o \div S; \qquad (2)$$

hence,

$$S = (W_o \div W_s)^{1/2}. \qquad (3)$$

That is to say, *in a single-phase induction motor the speed is equal to the square root of the secondary efficiency.* When the speed varies only a few per cent from synchronism the slip is equal to one-half of the secondary loss expressed in per cent, as was pointed out by Mr. B. A. Behrend on page 884 of the issue of the Electrical World and Engineer for December 8, 1900. Thus at a speed of .98 the secondary efficiency is .9604; the slip is .02; the loss is .0396. It is interesting to observe in this connection that in a polyphase induction motor the speed is equal directly to the secondary efficiency.

Combining equations (1) and (3) above, it is found that the torque has the following value:

$$D = (W_o \times W_s)^{1/2}. \qquad (4)$$

That is to say, the torque is equal to $(P Q \times P R)^{1/2}$, from Fig. 3, as used above.

It is especially worthy of note that the speed and torque as here determined are not affected by the substitution of the modified circuits of Fig. 2 for the more nearly exact circuits of Fig. 1. The method here outlined gives correct results both at synchronism and at standstill, and at other intermediate speeds the slight errors introduced are of both positive and negative values, and they tend to cancel in the final results.

On account of the fact that at speeds below synchronism there is a slight decrease in the "transformer-field" current and a large decrease in the "speed-field" current (as it reacts upon the primary), while Fig. 2 assumes both of these currents to be constant, the operating power factor of a single-phase motor is somewhat greater than that shown in Fig. 3. The discrepancy is appreciable only in those cases where the "synchronous no load" current is large in comprison with the starting current. Thus Fig. 3 gives the power factor accurately for large motors, but small motors will show better power factors than there indicated.

It is instructive to compare the performance of a certain polyphase motor, when operated normally, with that of the same machine when used as a single-phase motor. Using "equivalent single-phase" quantities throughout, the polyphase starting current of the motor whose single-phase circle diagram is shown by the arc $O P F K$ in Fig. 3, would be represented by the line $M F F'$ (not completely drawn) having a length equal to twice that of the line $M F$ (not drawn). The polyphase current locus is a circle passing through F' and O, its center being on the line $O N$ prolonged. If the machine is operated as a single-phase motor at a certain primary current, such as shown by $M P$ in Fig. 3, the output is $P Q$, as noted above. If the same output is to be obtained when the machine is operated polyphase, then the "equivalent single-phase" value of the polyphase current will be $M P'$ (not drawn), the line $P P'$ being (practically) parallel with the line $O F$. Thus the volt-amperes input as a single-phase machine is greater than as a polyphase machine in the ratio of $M P$ to $M P'$, and the power factor is less in the ratio of $cos\ E M P$ to $E M P'$; the losses are greater.

Although the circular diagram as developed above is applicable to all types of single-phase induction motors, the comparison just made refers exclusively to polyphase motors and the same motors used on single-phase circuits. The comparison between single-phase and polyphase machines is not quite so unfavorable to the former when each machine is designed primarily for its particular work. When a polyphase motor is operated as a single-phase machine, only a portion of the primary copper is fully employed; evidently a greater output can be obtained by altering the interconnections of the coils so as to use all of the copper.

With an induction motor having uniformly distributed coils, when the iron is subjected to the same magnetic density and frequency, and the same current density is used in the copper, the output varies largely with the groupings of the coils. Thus it may be shown that with such a motor the volt-ampere input can be represented, relatively, by the periphery of a polygon having sides equal in number to the number of groups per pair of poles, of which polygon the circumscribing circle represents the volt-ampere input for infinite groups, and double the diameter represents the input to the single-phase motor. Giving to the diameter of the circumscribing circle an arbitrary value of unity, the inputs to the machine for various groupings of coils are as follows:

No. of groups.	Type of machine.	Volt-ampere input.
2	Single-phase	2.000
3	Three-phase	2.598
4	Four-phase (Two-phase)	2.828
6	Six-phase (Three-phase)	3.000

Since the coils of commercial two-phase induction motors are grouped similarly to those of a four-phase machine and the coils of a three-phase motor are arranged similarly to those of a six-phase machine, a three-phase motor has a volt-ampere input 1.061 times that of a two-phase motor (on the basis of equality of losses), while the volt-ampere input of a single-phase motor is .707 times that of an equivalent two-phase machine. The further discussion of these relations is beyond the scope of the present article.

Measurement of Feeble High-Frequency Currents.

By Bela Gati.

AMONG the various methods which have been proposed for measuring feeble high-frequency currents, those of Duddell and Kennelly are, perhaps, the most interesting. According to the description of the Duddell thermo-galvanometers, in using a heater having a resistance of 13,910 ohms a deflection of 250 mm. at a scale distance of one meter is obtained with a current of 31 micro-amperes, while a heater having 18 ohms resistance required 800 micro-amperes to give the same deflections.

A heater with a large resistance can be advantageously used to measure voltage. Thus in Fig. 1 the voltage at the end or

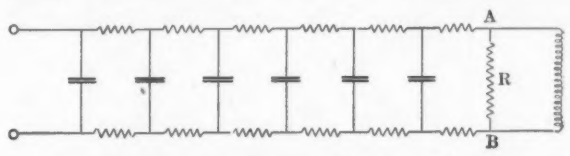


FIG. 1.—ARRANGEMENT FOR DETERMINING VOLTAGE BY MEANS OF SHUNTED RESISTANCE.

beginning of the lines can be determined if the current through the shunted resistance, $A B$, is measured. Let this current be I_1 micro-ampere, the resistance, R; the voltage at $A B$, $E_2 = I_1 R$. If $E_2 = 0.1$ volt $= 100{,}000$, $10^{-6} = 100{,}000$ microvolts; and if $R = 10.000$ ohm, then $I_1 = 10.10^{-6} = 10$ micro-ampere, which can readily be measured. It might seem at the first glance that the shunting does not correspond to conditions in practice, but it can be shown that the shunting of 1,000 ohms would be sufficient, especially in long-distance telephony, to represent the real practical conditions.

Similar results may be obtained by heating a series of Rubens thermo-elements with a Duddell heater, and measuring the current of the thermo-battery by means of a sensitive galvanometer. The sensitiveness of the latter arrangement, however, seems not to be equal to that of the Duddell thermo-galvanometer.

Better results are secured by employing Fessenden solid barreters, the use of which for telephone currents Kennelly described in a paper read before the recent International Electrical Congress. Kennelly places a condenser between the transmitting line and the barretter set, and measures the current strength at the end of the line. He determines from this current strength and from the e.m.f. measured in the beginning of the line the receiving end impedance, and from this receiving end impedance deduces the condition of the line (Fig. 2).

This system can be employed very successfully for testing a line, but care must be exercised if incorrect deductions are to be

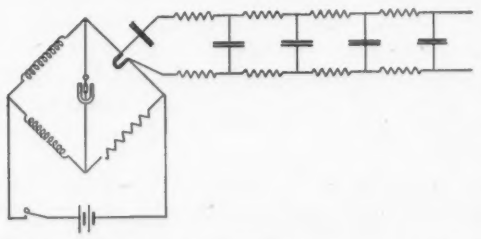


FIG. 2.—ARRANGEMENT FOR DETERMINING THE RECEIVING-END IMPEDANCE.

avoided. For instance, if the frequency is varied and the current is measured at the end of the line, the results obtained may not indicate the actual condition. It should be remembered that the strength of the telephonic current varies from point to point along the line, and that the form of the current wave varies with the frequency employed. If at a certain frequency a maximum current is noted in the measuring instrument, it is evident that at another frequency the current would not be maximum, but it would have some smaller value.

Fig. 3 shows the relation between the current strength and the frequency, as obtained in the loaded line from Wien to Innsbruck, when all or one-half of the applied Pupin coils were in circuit. Assuming the curves to be correct, it appears that

the high-frequency currents are very much weakened, but telephonic experiments do not justify this conclusion.

In order to obtain acceptable results, it is necessary to make measurements both at the end and at the beginning of the line of the strength, the e.m.f. and the power of the telephonic talk-

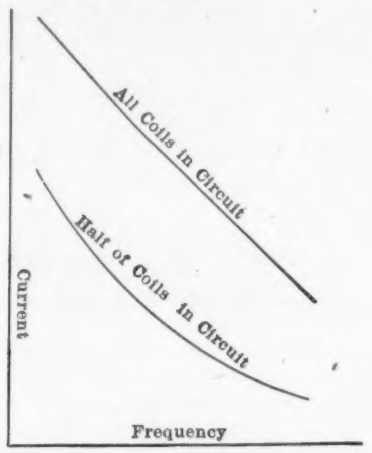


FIG. 3.—VARIATION OF CURRENT WITH FREQUENCY.

ing current; or, what is equivalent, instead of the power the lag between the current and e.m.f. may be noted. These measurements can be made very simply by the use of the three-ammeter method, of which Fig. 4 shows the principle, while Fig. 5 indicates the arrangements in detail.

The power consumed in coil T is $E_2 I_2 \cos \phi$. The power in

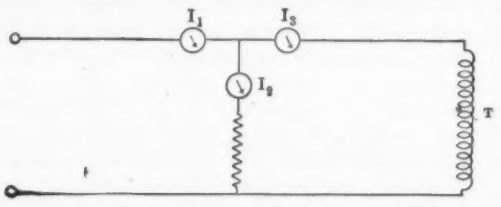


FIG. 4.—THREE-AMMETER METHOD OF MEASURING POWER.

coil T and barreter set III is $E_2 I_2 \cos \phi$. In the barreter set of Fig. 5 only the barreter consumes alternating power because the inductive resistances used are so high, in relation to the barreter resistance, that the alternating current flows only through the barreter. The barreter resistance is practically non-inductive,

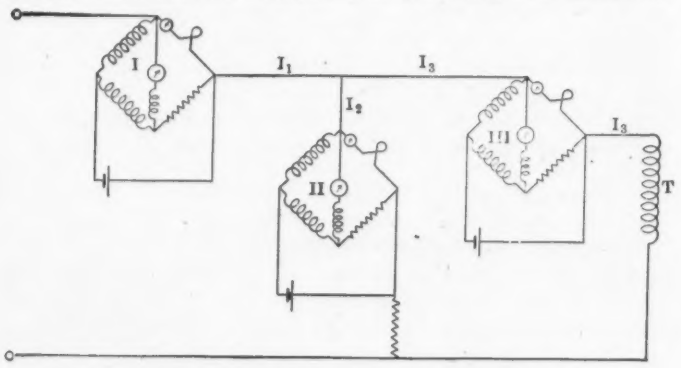


FIG. 5.—THREE-BARRETER METHOD OF MEASURING POWER.

and, therefore, the current is in phase with the e.m.f. $E_2 I_2 \cos \phi$ is to be calculated by means of the three-ammeter method, $R/2 (I_1^2 - I_2^2 - I_3^2) = E_2 I_2 \cos \phi$, where R is the non-inductive resistance, $R\ I_1\ I_2\ I_3$, are measured, and, therefore, $\cos \phi$ may be found from the expression $\frac{E_2 I_2}{E_2 I_2} \cos \phi - \cos \phi$ To get the power in coil T from $E_2 I_2 \cos \phi$ there must be subtracted the power consumed in the barreter. This power is in most cases very small, so that it may be neglected. By means of these measured and estimated data, it is possible to calculate the effective (ohmic) resistance, effective inductivity and capacity, and also the "conductance."

Kennelly indicates in the above-mentioned paper that a current as small as 3/5 micro-ampere may be measured. This value is sufficiently small for telephonic currents, but in wireless telegraphy and in supermarine experiments it is necessary to obtain a greater sensitiveness. It seems desirable, therefore, to discuss the means by which the sensitiveness may be increased.

The barreter is made from a very thin platinum wire. Wires having a diameter less than 20 micrometers may be manufactured and handled only when they are covered with some other metal which can subsequently easily be dissolved. The platinum wire is ordinarily covered with silver. When the experiments of the author were begun no wire smaller than 10 micrometers in

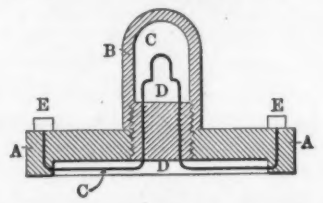


FIG. 6.—CROSS-SECTION OF BARRETER.

diameter could be obtained in Europe. Recently, however, the writer has stretched wires to reduce them to about 5 micrometers in thickness. Lately a platinum manufacturer, incited by American results, has also conducted some experiments, and he now makes wires 0.5 micrometer thick, and it does not seem impossible to make wires with 0.1 micrometer diameter.

The dissolving of the silver from a three-micrometer wire is not difficult. Moreover, it is not necessary to use wires as thin as those above-mentioned, because with thin wires it is impossible to use large measuring currents in bridge branches, as the barreter will be burned. When the galvanometer receives the smaller current it will not be so sensitive. Fig. 6 shows the barreter in the form used in the writer's laboratory in Budapest. $A\ A$ is a fibre plate, B a fibre capsule, D an ebonite stopper with screws, C are the barreter wires and E the terminals.

In Fig. 7 the barreter is placed in branch 2-2 of the Wheatstone bridge, in which is also placed a milliammeter. The branch 4-4 contains the resistances needful for preserving the balance of the bridge, together with a slide wire resistance. 1-1 and 3-3 branches have 1,000-ohm resistances with great inductivity, having iron cores and covered with iron wires. In the branches 6-6 is the battery having a small resistance; in branch 5-5 there is placed a reflecting galvanometer of great sensitiveness provided with shunts and having a small ohmic and a large inductive resistance. The bridge is placed in such a way that when the reading is about 2 milliamperes on the ammeter, the galvanometer does not show any deflection. Since the resistance 1-1 and 3-3 are equal for all strengths of the current, the re-

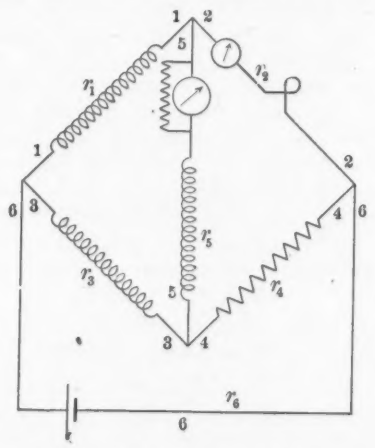


FIG. 7.—ARRANGEMENT OF SINGLE BARRETER SET.

sistance of 4-4 must be equal to that of 2-2 if the galvanometer deflection is to be zero. As shown in Fig. 8, there is connected to the barreter set, I, the resistance of the current source and the set II combined with set III. It is necessary to change the resistance in branch 4-4 till the galvanometer does not show a deflection. The barreter having about 20 ohms, the resistance, R, 1,000 ohms, and the coil of the current source about 1,000 ohms; if the resistance of the coil, T, is not too small it will be unnecessary to make a large change in the resistance of the branch 4-4.

To estimate the sensitiveness, it is necessary to know the current in the galvanometer branch. This current is i_5, where

$$i_5 = \frac{B\ (r_2 r_3 - r_1 r_4)}{N},$$

where r_1, r_2, r_3, r_4, r_5, r_6 are the resistance in the respective branches, and B is the e.m.f. in branch 6-6, while N is an expression for the sum of five terms; that is,

$$\begin{aligned} N = {} & r_5 r_6\ (r_1 + r_2 + r_3 + r_4) \\ & + r_6\ (r_1 + r_3)\ (r_2 + r_4) \\ & + r_5\ (r_1 + r_2)\ (r_3 + r_4) \\ & + r_1 r_2\ (r_3 + r_4) + r_3 r_4\ (r_1 + r_2) \end{aligned}$$

Since the value of i_5 depends upon seven variables, it is difficult to obtain a simple expression for its maximum. It is to be

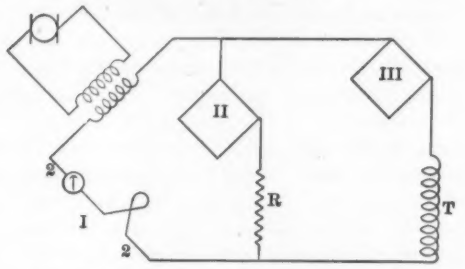


FIG. 8.—COMBINATION OF BARRETER SETS.

noted, however, that i_5 increases as r_5 and r_6 are decreased. The barreter resistance should be a minimum, so that the power consumed by the barreter may be very small and practically negligible.

In dissolving the silver from the platinum wire, at the first dipping into nitric acid, a resistance of 20 ohms is ordinarily obtained. Now, r_3 is also about 20 ohms, while r_1 and r_2 can be made as large as desired. For instance, if the increase in barreter resistance, r_2, caused by the superposed alternating current is 0.01 ohm, then the final value of r_2 is 20.01, 20 ohms being the resistance without the superposed current; the resistance of r_4 remains 20 ohms, the temperature coefficient of the manganin wire being low and therefore negligible. When $r_1 = r_2 = 1{,}000$ ohms the coefficient of B in the equation above is $(1{,}000 \times 20.01) - (1{,}000 \times 20) = (20{,}010 - 20{,}000) = 10$; if $r_1 = r_2 = 100{,}000$, the coefficient will be $(2{,}001{,}000 - 2{,}000{,}000) = 1{,}000$; that is, it will be 100 times larger than the above. However, i_5 does not increase 100 times, because N also increases with an increase of r_1 and r_2. With an increase of r_1 and r_2 it is necessary to use

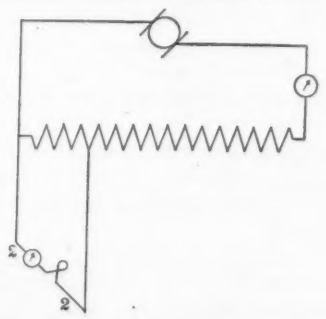


FIG. 9.—TEST TO DETERMINE RESISTANCE OF BARRETER.

a larger e.m.f. in the battery in order that the same current may circulate in the barreter branch. With a larger battery e.m.f., i_5 will also be larger.

It is necessary to know just what value of alternating current corresponds to each increase in the resistance of the barreter. To test this the connections shown in Fig. 9 may be used. Through the barreter is passed a current the strength of which can be accurately measured by means of precision transformers or the like. Since proper equipment was not obtainable it was found necessary to calibrate the instrument with direct current, assuming that the increase in resistance was the same with either alternating or direct current. For this purpose the impressed e.m.f. was increased in branch 6-6 (Fig. 7). The current through 2-2 became stronger and the change in the resistance of the barreter was noted. For instance, 1 milliampere increase gave 190 deflections. To return the galvanometer to the zero point, the resistance in branches 4-4 was changed. The deflection was diminished by 60° by a change of 0.1 ohm. The curve is shown in Fig. 10. The adjacent points are located on a straight line, and if, for instance, points 1 and 2 are found, point 3 between 1 and 2, or near 1 or 2 can be located. Each division on the milliammeter scale represented 0.1 milliampere; for more accurate measurement it is possible to use a galvanometer shunted with low resistance, the shunt being put in series with the barreter.

In measuring telephonic talking currents the galvanometer in the

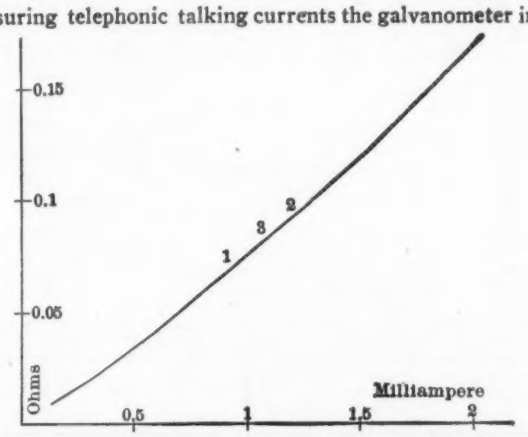


FIG. 10.—RELATION BETWEEN RESISTANCE AND CURRENT.

branch 5-5 (Fig. 7) will have a very rapid motion. The increasing and decreasing of the barreter resistance is almost momentary, and therefore the spot of light from the mirror is in constant motion. If the galvanometer is properly damped it is possible to avoid these variations, which might otherwise render the accurate reading of the deflection impossible.

The method outlined above does not require a special source of current, and any type of high-frequency generator may be employed. Since a Wheatstone bridge set is to be found in every laboratory, it is evident that high-frequency investigations can easily be made.

The Resistivity Temperature-Coefficient of Copper.

BY DR. A. E. KENNELLY.

IT is now generally admitted that a conductor of good commercial copper increases uniformly in resistance with uniform increase in temperature, or follows a straight-line law of resistance with respect to temperature between 0° and 100° C. The temperature coefficient of copper resistivity is taken by the American Institute of Electrical Engineers as 0.42 per cent per degree Centigrade with reference to the value at zero Centigrade,* as represented in the accompanying figure, or in accordance with the formula

$$\frac{R_t}{R_0} = 1 + 0.0042\,t, \qquad (1)$$

where R_0 is the resistance of the conductor at zero Centigrade, and R_t the resistance at t° C.

If we take a winding of copper, such as a dynamo armature, and, commencing with resistance R_t, at a room temperature t°C., allow it to be warmed by electric current to a final resistance, $R_{t+\theta}$, at a certain temperature elevation θ° C., i. e., at a final temperature $(t+\theta)$° C., we have from (1):

$$\frac{R_{t+\theta}}{R_0} = 1 + 0.0042\ (t+\theta) \qquad (2)$$

The two equations, (1) and (2), permit the temperature elevation, θ°, to be determined having given $R_{t+\theta}$ and R_t. For example, we may find from (1) the resistance, R_0, which the winding would offer at 0° C., and then inserting this value in

*See Standarization Rules of the American Institute of Electrical Engineers.

(2) we may find $(t+\theta)$ and thus the temperature elevation, θ.

It is the object of this article to show that a much shorter and simpler computation can be made with the aid of the subjoined table, using the single formula:

$$\frac{R_{t+\theta}}{R_t} = 1 + \alpha\theta, \qquad (3)$$

where α is a temperature coefficient varying with the initial temperature, t, and which becomes 0.0042, as in (1), when $t = 0$. We have in fact the following values of the temperature coefficient approximately:

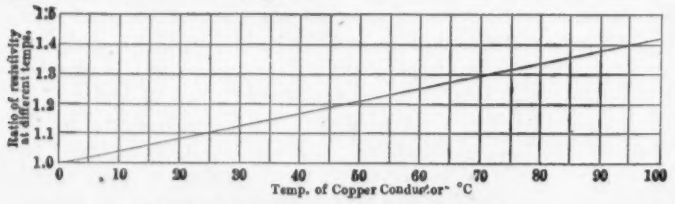
when $t = 0°$ C.	$\alpha = 0.0042$
$6°$	0.0041
$12°$	0.0040
$18°$	0.0039
$25°$	0.0038
$32°$	0.0037
$40°$	0.0036
$48°$	0.0035

In the following table the coefficient α is multiplied by 100, or appears at its percentage value:

Table of Temperature Coefficients of Resistivity in Good Commercial Copper at Different Initial Temperatures Centigrade.

Initial temperature °C. t	Temp. coefficient. in percentage per degree Cent. $\alpha \times 10^2$	Initial temperature °C. t	Temp. coefficient. in percentage per degree Cent. $\alpha \times 10^2$
0	0.4200	26	0.3786
1	0.4182	27	0.3772
2	0.4165	28	0.3758
3	0.4148	29	0.3744
4	0.4131	30	0.3730
5	0.4114	31	0.3716
6	0.4097	32	0.3702
7	0.4080	33	0.3689
8	0.4063	34	0.3675
9	0.4047	35	0.3662
10	0.4031	36	0.3648
11	0.4015	37	0.3635
12	0.3999	38	0.3622
13	0.3983	39	0.3609
14	0.3967	40	0.3596
15	0.3951	41	0.3583
16	0.3936	42	0.3570
17	0.3920	43	0.3557
18	0.3905	44	0.3545
19	0.3890	45	0.3532
20	0.3875	46	0.3520
21	0.3860	47	0.3508
22	0.3845	48	0.3495
23	0.3830	49	0.3483
24	0.3815	50	0.3471
25	0.3801		

As an example of the use of the above table, suppose that a dynamo armature winding has a resistance of 0.23 ohm at an



CURVE OF TEMPERATURE COEFFICIENT.

initial room temperature, $t = 25°$ C., and after carrying a load increases its resistance to, say, 0.271 ohm. What is the temperature elevation?

The increase in resistance, being in the ratio $\frac{0.271}{0.23} = 1.1783$, is 17.83 per cent. The tabular temperature coefficient for the initial temperature of 25° C. is 0.3801 per cent. Consequently, the temperature elevation, $\theta = \frac{17.83}{0.3801} = 46.9°$ C.

Example 2.—A copper wire has a resistance of 400 ohms at 11° C. What will be its resistance at 55° C.?

The tabular temperature coefficient for 11° C. is 0.4015 per cent per degree C. The temperature elevation is 55° — 11° = 44°. The increase of resistance will be 44 × 0.4015 = 17.67 per cent, or in the ratio 1.1767. The final resistance will thus be 400 × 1.1767 = 470.68 ohms.

The use of the table will, it is believed, distinctly simplify all winding temperature computations.

Transformer Efficiency of Telephonic Induction Coils, as Related to Long Distance Transmission.

By D. MacL. Therrell.

IN the transmission of a simple electrical wave over a conductor of great length characterized by high resistance, electrostatic capacity and conductive leakages, the power lost or dissipated is proportional to and expressible in simple terms of the reactive constants of the system, and there is no distortion of the wave form.

Such, however, is not the case for a complex electrical wave composed of a plurality of co-existing waves such as those involved in the telephonic transmission of the human voice, which are composed of a prime or fundamental and an ascending series of partials corresponding to the overtones, of articulation and quality. These characteristics are, however, far from being responsible for the limitations of present long-distance telephonic transmission.

While conceding that great losses are properly chargeable to the dissipation in the main line conductors, owing to their electrical characteristics as outlined above, special researches by the writer have shown that, in so far as long aerial lines are concerned, operating under actual conditions—which may be called existing meteorological conditions—little, if anything, of average and permanent value is to be obtained by a tuning or adjustment of the line constants, but that much may be gained by improving the methods and apparatus in use for the electrical transformation and transmission of the primary power equivalents of the voice.

In the art of telephony there is used a primary circuit including a variable resistance in relation to a diaphragm, a source of electrical energy and the primary winding of an induction coil or transformer. The primary current being of the variable or pulsating type is capable of transformation by means of an induction coil or transformer, the primary of which is included in circuit with the ordinary variable resistance and source of energy, while the secondary is connected into the main line. By this means it is possible, even with the small current to which we are restricted by the transmitter, to so step up the voltage impressed upon the main lines as to reach over relatively vast distances. But in saying this it must be admitted that such results speak far more for the sensitiveness of the receiver than for the efficiency of transformation or transmission. For, though ordinarily we may have flowing in the primary circuit something like .3 of an ampere, the maximum value of the current impressed upon the main line, on long circuits, is not more than .0001 of an ampere, for the lowest frequency with a far greater loss in transformation for the higher frequencies.

In order to successfully effect the long-distance transmission of speech, the prime requisite is an increased power efficiency of the system for each and every frequency involved, and particularly for such frequencies as correspond to the overtones or speech characteristics, if the speech so transmitted is to be satisfactorily intelligible.

Long-distance transmission of telephonic currents make it necessary to raise the line potential by transformation. There is, however, a limit in thus obtaining the necessary main line potential beyond which we may not go, and wherein much is lost to telephony. To throw light on this point, it is well to consider briefly the secondary e.m.f. as produced in a transformer.

If there were no impedance voltage losses in the transformer, the secondary e.m.f. would be equal to the primary e.m.f. multiplied by the ratio of transformation. When the secondary carries current, however, the internal secondary e.m.f. is much reduced from this apparent value. Where the magnetic leakage is small, the secondary current on short-circuit has a value represented by the equation

$$I_2 = \frac{\frac{t_2}{t_1} E_1}{R_2 + \left(\frac{t_2}{t_1}\right)^2 R_1},$$

where I, E, R and t represent the current e.m.f. resistance and

turns, respectively, the subscripts referring to primary or secondary quantities as indicated.

This equation shows the limitations of transformation for effective secondary potential. Furthermore, it not only shows that the apparent secondary potential must be divided by the secondary impedance, but that the primary resistance is a factor transferred to the secondary, and that the transformation ratio is also a factor in the divisor which increases as the square, while the secondary resistance increases directly. To illustrate, consider a transformer in which $t_1 = 400$, $t_2 = 2{,}400$, $R_2 = 60$ ohms. From the equation we would get a certain secondary current. Suppose the secondary turns, t_2, to be doubled, or made 4,800, what would be the result? It is admitted that we should obtain a secondary potential on open circuit of twice the original value, but since we have increased the secondary resistance to 120 ohms, and the square of the transformation ratio from 36 to 144, it is readily seen by substitution that insofar as secondary current on short-circuit is concerned, we have lost by the operation. This is one reason why telephonic transformers have not been operated on a transformation ratio beyond a certain moderate value.

Another reason is that a high transformation ratio has heretofore meant high secondary impedance, which resulted in a greater drop of potential across the secondary terminals, than across the receiver terminals, considering the receiving station or terminal of the circuit. This not only reduces the effective current through the receiver and thereby impairs the transmission, but it seriously interferes with the voice harmonics or overtones, as a result of wave reflection and dissymmetry of wave propagation, due to the position of the secondary impedance in relation to the receiver in the circuit. And, it is well known by telephone engineers that by shunting out the secondary of the high-potential coils, the efficiency of the receiver is raised by 50 per cent or more.

Having the problem stated, consider now the proposition of controlling the apparent primary self-induction, and rendering it independent of the secondary or line current. This can be done by the use of capacity in series in the primary circuit, whereby the apparent primary self-induction may be wholly or partially neutralized for any desired frequency, thus greatly increasing the primary current and thereby the secondary current in the main line.

The condition of perfect neutralization is possible only when

$$2\pi f L - \frac{1}{2\pi f C} = \text{zero, for any given period or frequency. For}$$

any periodicity above or below this, the two values will not cancel, and perfect resonance will not obtain.

The writer has found, however, that when a circuit is made resonant for any particular frequency, say, 250 p.p.s., the effects are experienced by all frequencies above 250, but in a gradually decreasing value.

One numerical example will be considered for the purpose of illustration. Assume a primary circuit including an induction, or transmitter coil, of the following constants:

$$R_1 = .5 \text{ ohm},$$
$$R_1 \text{ external} = 9.5 \text{ ohm},$$
$$L_1 = .022 \text{ henry},$$
$$E_1 = 10 \text{ volts}.$$

From the curves of Fig. 1 it will be seen that this circuit and coil, listed therein as circuit No. 4, offers an impedance of about 34 ohms to a current of 250 p.p.s., and that for a frequency of about 750 p.p.s. the impedance is more than 103 ohms.

Fig. 2 shows a series of curves of current resulting from the impedance in the circuits shown in Fig. 1 corresponding to the circuits and constants given, under the impressed e.m.f. of 10 volts. Thus, in Fig. 2, circuit 4, it is seen that for an impedance of 34 ohms $= \sqrt{R^2 + (2\pi f L)^2}$, and a frequency of $f = 250$, we get only .29 amp., while for 750 p.p.s. we get .097 amp. This is upon the assumption of the secondary being on a line of 8,000 ohms, or approaching open circuit.

Let us introduce into the primary a capacity, C. The primary impedance is then determined by the equation

$$I_m = \sqrt{R^2 + \left(2\pi f L - \frac{1}{2\pi f C}\right)^2}$$

Assuming $f = 250$ p.p.s., and that $2\pi f L - \frac{1}{2\pi f C} = 0$, then the reactance reduces to zero and the current rises to the value given by $I = \frac{E}{R}$. In the case under consideration this neutralization is obtained by a capacity of approximately 18 microfarads and the primary current rises from .29 amp. to 1 amp. as a result

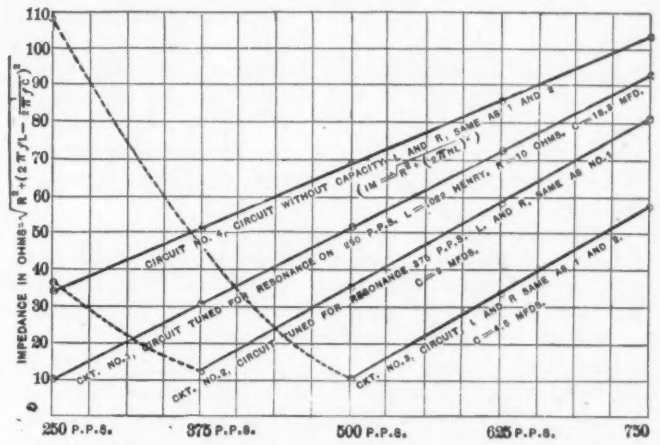

IMPEDANCE IN OHMS = $\sqrt{R^2+(2\pi fL-\frac{1}{2\pi fC})^2}$
CIRCUIT NO. 4, CIRCUIT WITHOUT CAPACITY, L AND R, SAME AS 1 AND 2
CKT. NO. 1, CIRCUIT TUNED FOR RESONANCE ON 250 P.P.S. L = .022 HENRY. R = 10 OHMS. C = 18.2 MFD.
CKT. NO. 2, CIRCUIT TUNED FOR RESONANCE 375 P.P.S. L AND R, SAME AS NO. 1. C = 8 MFDS.
CKT. NO. 3, CIRCUIT, L AND R SAME AS 1 AND 2. C = 4.6 MFDS.
250 P.P.S.
375 P.P.S.
500 P.P.S.
625 P.P.S.
750

FIG. 1.—IMPEDANCE AT VARIOUS FREQUENCIES OF A CIRCUIT, CONTAINING CONSTANT RESISTANCE AND SELF-INDUCTION, TUNED FOR RESONANCE BY DIFFERENT CAPACITIES.

of this capacity in the circuit. Reference to Fig. 2 will also show that for a frequency of 750 p.p.s. the current resulting from the partial resonance amounts to .108 amp., against .097 amp. for the same circuit without the capacity; thus indicating clearly the benefits of primary resonance for telephonic currents, even where the circuit is attuned, or syntonized to but one frequency. Now, we may divide the primary circuit into a plurality of circuits, and include in each branch the primary of an induction coil, together with the capacity necessary to tune it for any given frequency, as illustrated in Fig. 1 wherein the current values for identical circuits—with R and L constants the same in each—are

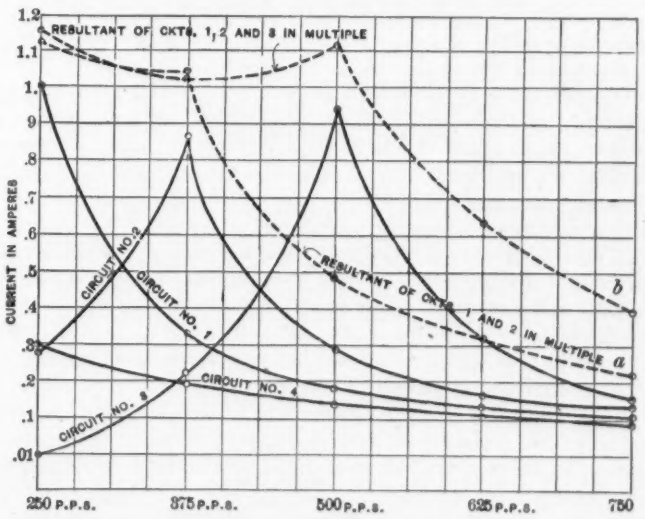


FIG. 2.—CURRENTS IN A CIRCUIT CONTAINING IMPEDANCES SHOWN IN FIG. 1, WHEN SUBJECTED TO 10 VOLTS.

shown for different periodicities, without capacity, and with the circuits tuned for the frequencies of 250 p.p.s., 375 p.p.s. and 500 p.p.s., respectively.

Fig. 2 also shows in dotted lines curves representing the values of current in the secondary circuit, wherein the secondaries are connected in multiple, giving the vector sum of the currents in the different coils. Curve *a*, Fig. 2, represents the resultant of the currents in coils 1 and 2 in multiple; curve *b* the resultant

of 1, 2 and 3 connected in multiple in the secondary, which is considered under short-circuit, at a transformation ratio of 1:1 neglecting losses.

Fig. 3 shows the arrangement of circuits as used in practice. Referring to this figure, it will be seen that there is a variable resistance, 1, in series with a source of constant potential, 2, in a closed circuit which divides at the points indicated by 3 and 4 into three branches.

One of these branches contains an inductance, *L*, with resistance adjusted to the other constants of the circuit, while the other two branches contain the primaries of induction coils or transformers 5 and 7 in series with capacities 6 and 8, of such value as to neutralize the inductance of the circuit and render the primary branches of the circuit resonant or partially resonant for given frequencies. But, while the circuit divides at 3 and 4 into three branches, the source of energy, 2, supplying a unidirectional current, can only cause a current to flow through the branch containing the low resistance inductance, *L*, the current through the other branches being stopped by the condensers, 6 and 8. This is the normal condition of the circuit when the telephone is not being used.

Consider now the result of varying the resistance, 1, where the constants of the circuit are as follows: normal resistance of the transmitter, 1, equal to 18 ohms; potential of battery, 2, equal to 10 volts; resistance of inductance, *L*, equal to 1 ohm; resistance of primary coils, 5 and 7, equal to .5 ohm.

Neglecting the internal resistance of battery 2, and the rest of the circuit, other than that of the variable resistance and the inductance, under normal conditions, 95 per cent of the potential of the battery, 2, falls across the variable resistance, 1, while 5 per cent is across the inductance, *L*, or points 3 and 4.

While no current flows ordinarily through the branches of the circuit containing capacities 6 and 8, these branches being a shunt around the inductive resistance, *L*, the condensers take a charge at a potential of .5 volt, which is the drop across *L*.

It follows, therefore, that if the variable resistance, 1, be suddenly lowered, say to 9 ohms, as is the case with a telephonic

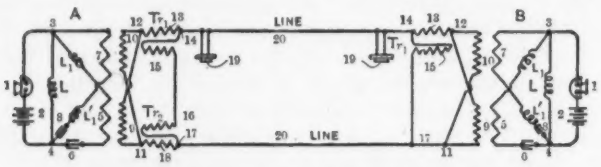


FIG. 3.—DIAGRAM OF TELEPHONE CIRCUITS.

transmitter when a sound wave strikes the diaphragm thereof, the potential across *L* will be proportionately raised, and the condenser, 6, takes a direct charge at 1 volt. Upon the movement of the diaphragm in the opposite direction the variable resistance, 1, is again raised through normal to maxima, thus reducing the potential across the condensers which discharge through inductive resistance, *L*, and the primary coils, 5 and 7, giving a current, assuming a condition of resonance, of .66 amp.; and thus with each excursion of the transmitter diaphragm the variable resistance, 1, is alternately increased and decreased, raising and lowering the potential across the terminals of the condensers, which, in being charged and discharged, produces an alternating current through the primary coils and transmits a similar alternating current to the line.

With an ordinary transmitter primary circuit, using the same primary coil, transmitter and e.m.f., with a voice frequency of 250 p.p.s., there would be obtained in the ordinary primary coil a current of .017 amp., as against .66 amp. for the resonant circuit. At Tr_1 and Tr_2 are shown compensating transformers of special design for the purpose of regulating the line voltages and reducing the terminal impedance.

Based upon the researches and the principles leading to the brief general discussion of the subject as outlined above, the writer has designed a system of long-distance telephonic transmission which has, under extended experimental tests over actual lines, proved eminently confirmatory of the theory involved, and has shown increases in efficiency of transmission and reproduction fully 100 per cent over standard transmission in every instance noted. The wave definition, or articulate characteristics, are remarkably striking.

Standard Ratios for Frequency Changers.

By R. A. Philip.

THE evolution of American alternating-current practice has gradually eliminated the use of numerous frequencies until there are now but two frequencies left which are regarded as standard, namely, 25 and 60 cycles.

For alternating lighting systems the use of 25 cycles has been impracticable on account of the appreciable fluctuation of light of the incandescent lamps, and especially of the arc lamps. For railway systems the use of 60 cycles has been less economical than the use of the lower frequency, on account of the maintenance of 60-cycle rotary converters being higher and the cost of 60-cycle motor-generators being higher and their efficiencies lower than that of 25-cycle rotary converters. The more recently developed single-phase railway motor can also be much more advantageously operated from the lower frequency. It, therefore, appears probable that each of these two frequencies will continue to be used for a long time.

Growth followed by overlapping and consolidation of properties will more and more bring up the question of the electrical interconnection of the two systems through frequency changers. The 25-60-cycle (i.e., 5:12 ratio) frequency changer may, therefore, be expected to develop into a piece of standard apparatus and its limitations are consequently of great importance.

For an electric machine of given type and size there is in general some speed which should be approximated to secure economical design. Thus, in designing belted units, a speed of 100 r.p.m. would be too low for a 10-kw machine and 1,000 r.p.m. too high for a 100-kw machine. The speeds which are available for alternators are rigidly limited to a certain progression downward from a maximum by the relation between the frequency and the number of poles, but a speed can usually be obtained which is a sufficiently close approximation to any desired speed. In the case of a frequency changer the number of available speeds is much further reduced by the fact that only speeds which are common to the two frequencies can be used. Thus, the maximum available speeds are 3,600 r.p.m. for 60-cycle machines, 1,500 r.p.m. for 25-cycle machines and 300 r.p.m. for 25-60-cycle frequency changers, and all available speeds, not lower than 100 r.p.m., amount to 36 for 60-cycle machines, 15 for 25-cycle machines and only 3 (as follows: 300, 150 and 100 r.p.m.) for 25-60-cycle frequency changers. This is a serious limitation, because a speed of 300 r.p.m. is much too low for the economical design of frequency changers of small or moderate size and the step from 300 to 150 r.p.m. is so great that only a very large machine would be designed for the second available speed. This practically limits the design to one speed, which is not suitable for most sizes in the range ordinarily desirable.

While there are only three speeds which are not lower than 100 r.p.m., which give the exact ratio of 25 to 60 cycles, there are numerous others which approximate to this ratio more or less closely. Thus, if a certain machine, with 14 poles, be coupled to another machine with 6 poles, a frequency changer will be obtained which will run at 514 r.p.m. when supplied with 60-cycle current, and will deliver 25.7 cycles, and will run at 500 r.p.m. and will deliver 58.3 cycles secondary from 25 cycles primary. Similarly a 60-cycle, 32-pole machine, and a 25-cycle, 14-pole machine will give 26.3 cycles at 225 r.p.m. and at 217 r.p.m. will give 57.1 cycles when operated from 60 and 25 cycles, respectively. Such odd combinations greatly increase the available range of speeds, and they give approximate frequencies sufficiently close for the proper operation of lamps, motors or other receiving apparatus, which may be connected to the system, but they have one vital defect. The essential function of a frequency changer is to unite two systems having different frequencies and it does not accomplish this result properly unless it provides for the future addition of other frequency changers which may run in multiple with it on both the primary and secondary side as required when the systems may be extended or consolidated with other systems also operating frequency changers. Machines giving the different odd combinations as illustrated above cannot run in multiple with each other or with frequency changers of the exact ratio, and they should, therefore, not be built.

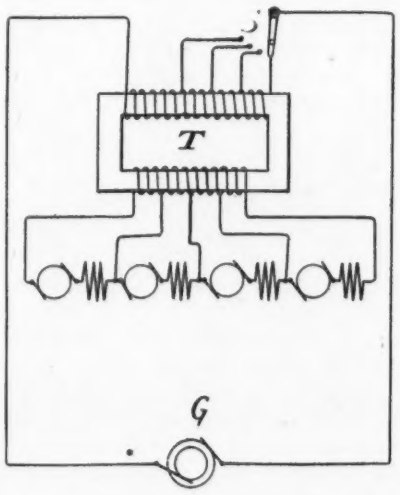
Considering the relation of the speeds of frequency changers to the series of speeds of the two alternating systems which are thereby united it is evident that the maximum speed of the frequency changer is the greatest common divisor of the maximum speeds of the two systems. A very small change in the relative frequency of the two systems will make a very great change in the greatest common divisor, and a small change if properly chosen may greatly increase the maximum available speed with excellent results. The most advantageous ratio which can be obtained approximating the ratio 25:60 is 24:60, giving 720 r.p.m. as a maximum instead of 300 r.p.m. Therefore, altering one frequency by 4 per cent raises the speed limit on the frequency changer by 140 per cent and gives 7 instead of 3 available speeds not slower than 100 r.p.m. Thus 24 to 60-cycle frequency changers may be built for 720, 360, 240, 180, 144, 120 and 103 r.p.m.

It is of course immaterial as far as it affects the frequency changer whether one frequency is changed from 25 to 24 cycles or the other from 60 to 62.5 cycles or whether each is changed a little as long as the ratio of frequencies is the same (i. e., 2:5), but considering the fact that the prevailing tendency is toward lower frequency it would appear better to lower the lower frequency rather than to raise the higher one, especially as this gives integral numbers for the expression of each frequency in cycles per second.

The essential point is the importance of discarding all odd ratios and of standardizing the ratio of frequencies at 2:5 instead of at 5:12.

Speed Control of Alternating-Current Motors

In a patent issued June 12 to Prof. D. C. Jackson means are described for proportionately dividing the line pressure between several alternating-current motors connected in series, in order to maintain a suitable apportionment of the work of the motors at all speeds. The arrangement proposed is indicated in the accompanying illustration. Use is made of an ordinary transformer, a switch being employed to place more or less of the primary winding in circuit according to the pressure desired for the motors. Since the armature and field windings of each motor are arranged in a locally closed electric circuit, each motor will operate as though the others were not present.



JACKSON MOTOR CONTROL.

It is stated that the method can be used with induction motors and repulsion motors as well as with series motors. It may also be used with polyphase motors, in which case an auto-transformer may be introduced with each phase in connection with the series-connected primary windings of the motors which belong to that phase, or a single auto-transformer related to one phase alone may be relied upon to suitably apportion the total impressed pressure.

New Telephone Patents.

NEW SWITCHBOARD CIRCUITS.

Fig. 1 shows a circuit for a switchboard in which the cord circuit has been simplified to the utmost, all relays being associated with the line circuit. A compound-wound relay permanently wired to the line serves the dual function of relay and retardation coil. A second relay wired to the jack sleeve serves as combined resistance and cut off relay. It will be seen that normally, with the telephone off the hook, the line relay lights the line lamp. When the plug is inserted the cut-off relay removes the line lamp and is of itself of such high resistance as

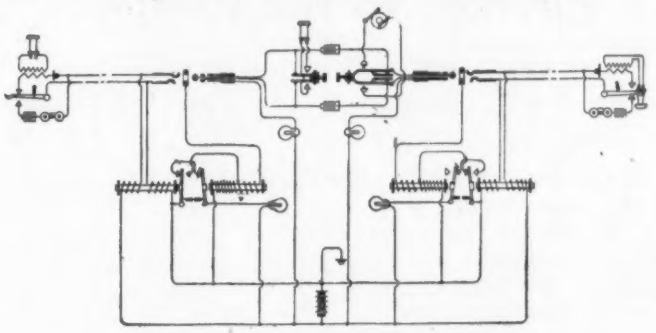


FIG. 1.—BOYCE TELEPHONE SYSTEM.

to prevent the lighting of the supervisory lamp in series with it. The falling back of the line relay armature shunts out part of the series resistance, i. e., part of the cut-off relay coil, and by this means permits the lighting of the lamp. C. L. Boyce, of Detroit, is the patentee, the Western Electric Company being assigned the patent.

Mr. M. S. Conner, of Chicago, has obtained a patent for the now familiar 12,000-ohm relay trunk circuit of the Bell Companies. It will be recalled that the 12,000-ohm relay, while itself operating, prevents the operation of certain other relays at the distant end of the trunk, until part of its resistance is shunted out. It was by this means that through lamp signals were obtained while grounds are confined to one end of the trunk only.

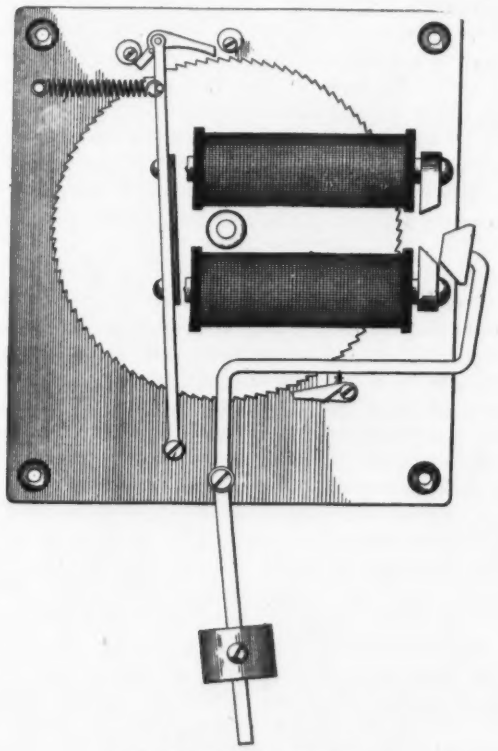


FIG. 2.—ENOCHS SELECTOR.

Mr. M. J. Kellogg has obtained a patent on a long-standing application, for a magneto system with oppositely polarized line and clearing out drop. Such an arrangement permits all drops to be permanently bridged.

A SIMPLE SELECTOR.

In Fig. 2 is shown a very simple form of selector for small automatic systems, the electromagnets being reduced to one. The operation is almost self-evident, the yoke armature being slow-acting and therefore unaffected by the rapid breaks in circuit necessary to operate the driving pawl. With all current cut off, however, the yoke armature restores and trips the retaining pawl. C. D. Enochs, of LaCrosse, is the inventor of this device, having assigned his patent to the Western Electric Company.

LETTERS TO THE EDITORS.

Motor-Generator Fly-Wheels.

To the Editors of Electrical World:

SIRS:—With reference to Mr. H. Ward Leonard's comments in your issue of April 21 on the article in your issue of March 3 entitled "Ward Leonard System in a German Colliery," it may be interesting to the public to know how the Ilgner system was started in Europe.

In the beginning of the year 1901 I worked out a project for operating an electrical winding engine at the Donners marckhütte, Upper Silesia. The electrical energy was available in a power station with 50-cycle, three-phase generators, 5,000 volts, driven by a gas engine. The power station was situated approximately 3 miles from the pit. The ordinary rheostatic control of the winding motor, which had approximately 700 hp capacity, was not advisable in view of the character of the power station and the high losses which would have been in the starting rheostat, owing to the starting period occupying a large part of the total cycle. It was, therefore, advisable to recur to a motor-generator consisting of a three-phase induction motor coupled to a direct-current generator according to the Ward Leonard system. This system had successfully been shown at the Paris Exhibition in 1900.

In order to overcome the overloads which the above mentioned power station would not have been able to handle a storage battery was taken into consideration, and the direct current generator for this apparatus divided in two, one with constant voltage and the other with variable voltage in order to allow for connecting the battery, and at the same time for the variable voltage control of the winding motor. This project, however, was found to be too expensive on account of the cost of the battery, and was rejected.

A new project was then worked out with the battery replaced by a fly-wheel, the use of a fly-wheel being well known from the steam engine and rolling mill practice in order to overcome load fluctuations during short periods. The characteristic of the induction motor, however, made it necessary to provide for a regulation of its input, and allow at the same time the flywheel to be discharged during the overloads. This could be easily effected by automatically inserting a resistance into the secondary of the induction motor so as to regulate for constant primary and secondary current, and for constant torque with a slip of the fly-wheel up to 15 per cent.

The machinery to suit this condition was laid out according to these instructions by the Westinghouse Electric & Mfg. Co., Pittsburg, and the undersigned went in August, 1901, with the complete project to the said company's district office at Breslau, handing the same to the sales manager of the district, Mr. Ilgner. The plant was never built and the said engineer left shortly after.

In 1902 at the Dusseldorf Exhibition the winding engine for the Zollern II Colliery in Germany was exhibited, but the control was by means of multiple voltage from a storage battery. The winding engine for the Preussen II Colliery driven by a three-phase motor was also shown in a drawing, but no motor-generator with fly-wheel was at this time put forward by the leading German electrical firms. It was not until the end of the year that a publication was made in the *Zeitschrift des Vereines Deutscher Ingenieure*, dated November 22, 1902, page 1794, that Mr. Ilgner and Siemens & Halske had developed a new winding system which, according to the description, was exactly the same as worked out by the Westinghouse company fifteen months previous.

The Zollern II Colliery later adopted the Ward-Leonard motor-generator with fly-wheel and automatic slip regulator, leaving the storage battery as a reserve. This was the start of the so-called Ilgner system, and up to this time there are more than 50 winding engines operated in Europe according to this system, one of the latest being the plant at the Mathias Stinnes Colliery, Germany, consisting of four large winding engines of 2,000 hp each, controlled by two motor-generators with a 40-ton fly-wheel each. When the whole installation is finished there will be running four Ward Leonard's sets, two of each being connected by an elastic coupling. The total motor-generator plant consists of four three-phase motors representing a constant load of 2,000 hp, four fly-wheels of 160 tons having an aggregate capacity of 500,000 hp-seconds approximately; eight direct-current generators with a maximum output of 9,200 hp (*Z. d. V. I.*, 1905, page 2075).

The essential difference between the Ward-Leonard motor-generator and the Ilgner system is in the automatic slip regulator, which in the case of a direct-current motor serves as an automatic field regulator. This slip regulator may be operated either by a centrifugal regulator or by a current relay connected into the mains from the power station, and tending to keep the current consumption of the motor-generator constant. Without this slip regulator the motor-generator with the fly-wheel would be of very little use, and I think it is this apparatus in connection with the Ward-Leonard motor-generator which is the essential characteristic of the Ilgner system.

The Ilgner motor-generator is to be used in Europe for driving the main rolls of rolling mills, the capacity of the machinery being several times in excess of the largest used for winding engines up to this time. Four rolling mills with capacities up to 13,000 hp, are being equipped at present.

MANCHESTER, ENGLAND. RUDOLF BRAUN.

Steel Line Construction and Lightning.

To the Editors of Electrical World:

SIRS:—I have noted with considerable interest the editorials in the ELECTRICAL WORLD dealing with lightning phenomena. They have at times contained suggestions of real value to the experimenters in this field, and should be even more helpful to the users of such apparatus in keeping their ideas moving in rational channels.

It should be borne in mind that the acquisition of information in this subject is a very tedious one, requiring care and the highest possible exactness to avoid misconception. For this reason I should like to take exception to your recent editorial of the issue of June 9, 1906, wherein certain new features are suggested for the investigation by the National Electric Light Association for the coming year, viz.: the effect of steel pole and tower constructions upon troubles from lightning. This is undoubtedly a point of great interest, and at present sufficiently general in its application to enable considerable data to be obtained, but it is after all only a small part of the information desired, and great care should be exercised not to let its novelty give it undue prominence in any future work, which such an organization might carry on.

I wish to emphasize by these remarks the need of concentrated co-operation in the study of such phenomena as the committee of the National Electric Light Association has begun so admirably, and to urge that it is above all else highly desirable that these observations in toto be repeated from year to year for a few years until a sufficient period has been passed to furnish fairly reliable conclusions.

BOSTON, MASS. N. J. NEALL.

Capacity Effect in Electric Shock.

To the Editors of Electrical World:

SIRS: I should like to take exception to a statement made in an editorial in your issue of June 2, under the head "Capacity Effect in Electric Shock." You say "It is similarly possible to receive a lesser momentary discharge, or shock, through a con-

denser coming into contact with a high-tension circuit. Thus, if a condenser be connected with the system and be left insulated at the other terminal, the connection of that terminal to ground through a person would be able to pass a momentary discharge through his body."

By grounding one leg of an alternating-current system, while that leg is passing through zero potential (that is, zero to earth) a momentary contact may be made between that leg and ground, and no shock or flow of current follow. If the contact is of long duration, a succession of shocks will be given for each rise and each fall of the alternating potential above and below the normal earth potential. If the contact is made when the difference of potential between that leg and earth is at its maximum, a large flow of current may follow, this current being of a temporary nature. It is caused by the sudden discharge of a condenser, in this case the condenser being made up of the line insulation and earth.

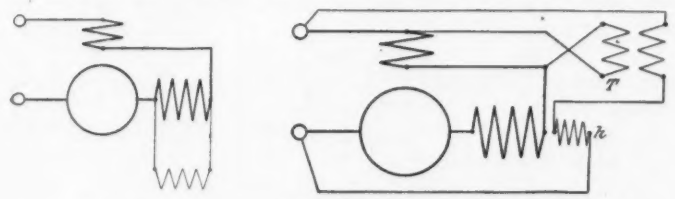
In large, high tension, alternating-current underground systems, where the capacity per leg to ground is large, the flow of current between one leg and ground, the system being insulated, is, say, 30 amperes distributed; that is, 30 amperes leaving the bus and falling of to zero along the line. By grounding one leg permanently and solidly, the current to ground through that contact would be, say, 50 amperes. On sudden application of a ground it might reach to 400 amperes, depending upon how the ground was made with respect to the voltage between that leg and the ground.

NEW YORK. T. W. VARLEY.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Single-Phase Series Motors.—RICHTER.—The first part of a long article illustrated by numerous diagrams. The author remarks that only recently the single-phase series motor has been so improved that it is almost as good as the direct-current series motor. The points in which the single-phase series motor is inferior to the direct-current series motor are the starting period (that is, with the same effective motor current the torque of the single-phase motor is smaller than that of the direct-current motor), commutation, capacity for continuous use for given dimensions, efficiency and power factor. In the present article the author gives a detailed summary of the various devices which are being employed by the Siemens-Schuckert Company in order to improve the deficiencies of the single-phase motor just mentioned. The author first deals with improvements in starting and describes several constructions of inserting resistances between commutator and armature windings. In the latest construction of the Siemens-Schuckert Company these resistances are wires which are provided not only for increasing the resistance of the short-circuited windings "below the brushes," but they are employed in the form of a special open armature winding in series with the main winding, and are so designed that they increase the capacity and efficiency of the motor. The theory and construction is explained in detail. The author then discusses commutation and describes a great many different constructions. In the latest designs of the Siemens-Schuckert works the series motor is claimed to be superior to the compensated repulsion motor in every respect, as far as the suppression of sparks is concerned. Two of these latest constructions are reproduced in Figs. 1 and 2. In Fig. 1 a resistance is connected in parallel to the compensation winding. Fig. 2 represents a special arrangement devised by Schenkel. Its characteristic feature is the provision of a transformer, *T*, which introduces an e.m.f., which if it was the only one would produce in the auxiliary winding, *h*, a flux compensating the commutation voltage. The polar diagram of this arrangement is given in the article. The article is to be concluded.—*Elek. Zeit.*, June 7.



FIGS. 1 AND 2.—SINGLE-PHASE SERIES MOTORS.

Exciting Current of Induction Motor.—MCALLISTER.—A mathematical note on the best method of predetermining the wattless component of the no-load current (the exciting current). The author shows that the value of the wattless component may be ascertained directly from the volume of the air-gap and the volume of the core material, without reference to the required magnetomotive force, the number or the distribution of the primary coils. The maximum magnetic density and the permeability of the iron must be known. In other words, the very quantities which are necessary in order to determine the core losses will serve simultaneously for the determination of the (quadrature) exciting watts, when the permeability of the core is known. An empirical formula for the permeability of iron, sufficiently accurate for most practical purposes, is given. The (quadrature) exciting watts of a certain polyphase motor are the same in value when all phase windings are used, or when only one winding is subjected to the primary pressure. Thus, when one phase winding of a two-phase motor is open-circuited, the other winding immediately takes double its former value of (quadrature) exciting current, the (quadrature) exciting watts remaining the same. Therefore, the most logical way to determine the exciting current of an induction motor is to ascertain the density of the magnetism in the core and in the air-gap, and then to calculate the quadrature watts, just as one ordinarily calculates the core loss watts.—Lond. *Elec.*, June 8.

High-Tension Transformer.—NAGEL.—An illustrated description of a 400,000-volt, 200-kw transformer, built by the Siemens-Schuckert works for cable testing. Several new improvements are employed in the design.—*Elek. Bahnen*, May 23.

Lamps and Lighting.

Lighting of Railway Carriages.—An illustrated description of the Vickers-Hall system of electric lighting for railway carriages. —Lond. *Elec. Rev.*, June 1; a correction of a diagram in Lond. *Elec. Rev.*, June 8.

Traction.

Adhesion Weight of Electric Locomotives.—OSSANNA.—A great advantage of the electric locomotive over the steam locomotive is the smaller weight and especially the more favorable ratio of the total weight of the locomotive to the adhesion weight (whereby in the case of steam the weight of the tender is to be added to that of the locomotive). With electric locomotives the adhesion weight may easily be made equal to the locomotive weight, but this is never possible with steam locomotives. In case of steam there are actual cases in which the adhesion weight is not one-third of the locomotive weight, and even with high-speed locomotives for mountain roads the adhesion weight is generally not one-half the locomotive weight. With the same adhesion weight, direct-current or three-phase current locomotives can develop greater tractive force than steam locomotives, because the torque of the former is constant, while with steam locomotives the maximum torque is greater by 15 or 20 per cent than the average torque. Thus in some cases of actual electrical practice the ratio of tractive force to adhesion weight is 1 to 3.5, while such a ratio has never been obtained with steam locomotives. This advantage of direct-current and three-phase current locomotives over the steam locomotive would appear not to exist for single-phase locomotives because the single-phase commutator motors develop a torque which varies in a much greater degree than that of the steam locomotive. As a matter of fact the maximum torque of a single-phase commutator motor is about twice that of the average torque. From this it would seem that in order to prevent entirely any slipping

of the wheels on the rails, an adhesion weight is required twice that necessary for constant torque momentum. In this respect the single-phase locomotive would appear to be inferior even to the steam locomotive, but the author shows by mathematical analysis that this would be a wrong conclusion, and that as a matter of fact the single-phase locomotive is almost as good as the direct-current and three-phase locomotives in this regard. —*Elek. Bahnen,* May 4.

Electric Towing for Canals.—Block.—The continuation of his long detailed and fully-illustrated description of the recently opened Teltow Canal. Electric towing has been exclusively adopted. Electric locomotives run on rails on the tow path, being supplied with current from an overhead wire. At two places the canal passes through lakes, where it is impossible to tow the boats from a tow path so that they are to be hauled by tug boats. A great many tests were made with different kinds of tug boats. Electric tug boats were used, either equipped with a storage battery or supplied with current from a double overhead wire, but a tug boat provided with an oil engine was found most suitable. Absolute freedom from smoke was a necessity for æsthetic reasons. The two tow paths are provided with a track of one-meter gauge, with rails weighing 20 kg. per meter. Preliminary tests show that with a speed of 4 km. (2½ miles) per hour the tractive resistance is 0.85 kg. per ton of useful load, the total power 0.014 kw per ton and the energy consumption 3.5 watt-hours per ton-km. With a speed of 4.5 km. (2¾ miles) per hour, the corresponding figures are 1.035 kg., 0.021 kw, 4.25 watt-hours, with a speed of 5 km. (3 miles), they are 1.34 kg., 0.0284 kw and 5.25 watt-hours. The efficiency of the locomotive averaged about 65 per cent. The construction of the locomotive is shown in Fig. 3. It is provided with three axles.

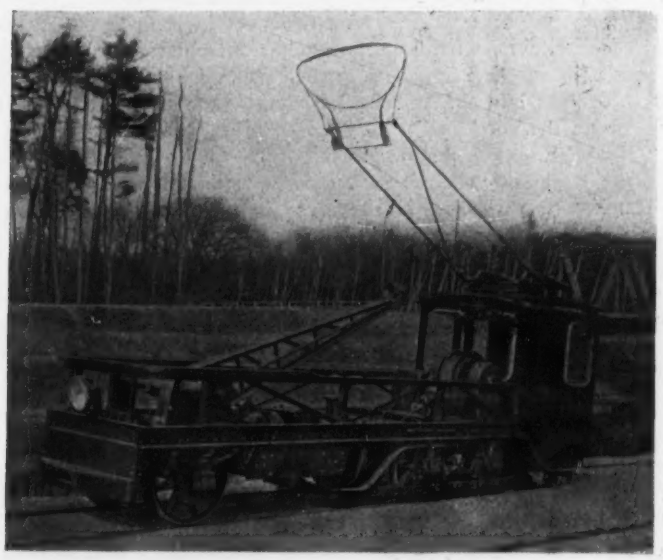


FIG. 3.—ELECTRIC TOWING LOCOMOTIVE.

Only the two at the front are driving axles, each being provided with a series motor of 8 hp capacity for continuous operation, when running at 800 revolutions at 550 volts direct current with double gearing. Above the back axle a horizontal axle is provided around which the towing pole may be turned so as to be raised or lowered. This is done with a 3-hp electric motor. The upper end of this towing pole has a funnel through which the towing cable runs. This steel cable, which is 10 mm. thick, is wound on a drum which is also electrically driven by a 3-hp motor. The winding drum is not firmly fixed to its axle, but is connected to it by means of a friction coupling; the springs are generally adjusted so that when the tractive force becomes more than 1,200 kg. the drum revolves around the axle and the cable slowly passes off from the drum. At starting where for a load of a 600-ton boat a tractive force of about 2,000 kg. is required, the cable is slowly wound off from the drum so that the locomotive is not subjected to heavy pulls. The towing pole is raised when the locomotive passes boats on the bank of the river, which are being loaded or unloaded. The article is to be continued.—*Elek. Zeit.,* June 7.

Electrolysis of Underground Pipes.—A general summary of the report of the Committee on Electrolysis of the American Gas Light Association, of which A. G. Glasgow is chairman and A. F. Ganz, of Stevens Institute, is consulting engineer. The conclusions of the committee are as follows: First, electric railways should be held responsible, by the terms of their franchise, for all damage to others engaged in the discharge of franchise obligations or in any lawful pursuit or occupation, caused by their overt failure to control their own currents. Second, the immunity of street piping and other metal in centers of population from electrolytic damage due to stray currents demands that electric railways shall employ in such districts completely insulated metallic circuits for all currents; and such railways may be especially exempted by ordinance from responsibility regarding electrolysis so long as they effectively maintain such circuits. Third, in small communities where local conditions are favorable, or wherever the property liable to electrolysis damage is of minor value, the rails may be used for the return current, subject to clause first, provided: (1) The potential difference in the rails be sufficiently reduced by properly balanced return feeders and through bonding (the "committee cannot indicate suitable local voltages, but it has been seen that the German commission commend a present maximum potential difference of one volt"). (2) The rail foundations be constructed to increase as much as practicable the resistance between the rails and earth; and (3) There be proper supervision to insure conformance with these requirements. Fourth, in rural districts, or wherever no property is liable to electrolytic corrosion the uninsulated rails may be used *per se* for the return current.—*Progressive Age,* June 15.

Mountain Road.—Hotopf.—The first parts of a detailed illustrated description of the electric equipment of the Filder road, which connects Stuttgart with the Filderebene, and which has a total length of 31.4 km. While most of the line is built as an adhesion road, a length of 2 km. is rack and pinion. The line is supplied with direct current at 600 volts; the motors are specially constructed for mountain roads and are shunt-wound so as to recuperate energy when going down hill.—*Elek. Bahnen,* May 23 and June 2.

Single-Phase Railway.—Some notes on progress made on the Swiss experimental railroad between Seeback and Wettingen. The Swiss Federal Railway authorities have completed their official tests on the section between Affaltern and Regenstorf, and a regular service is now running as far as the latter station. Some trouble was experienced at first from the interference of the power circuit with the telephones near the track, but this has now been to a great extent got over. Work is being pushed forward on the Regenstorf-Wettingen section; 4,700 train-miles have been run since the commencement of operations on January 15, 1905. The newer of the two locomotives, which has been in service since November 10, 1905, is equipped with some of the largest single-phase motors in use, being of 250 hp capacity each. As soon as the whole line is complete a new 1,000-hp express locomotive will be put into service. The whole of the equipment was supplied by the Oerlikon Company.—Lond. *Elec.,* June 8.

Electric Railways of Switzerland.—Mueller.—In Switzerland the total length of electric roads is 15.8 per cent of all railroads (against 6.8 in Germany). The author gives a great many statistical data in very concise form on all Swiss electric railways. —*Elek. Bahnen,* May 4 and 14.

Block Signals.—An illustrated description of the block signal and interlocking system adopted for the electric zone of the New York Central lines in New York City. Alternating current is used for signal operation, the track rails being retained for the return direct-current circuit.—*St. R'y Jour.,* June 9.

Installations, Systems and Appliances.

British Central Station Statistics.—A large table giving in 20 different columns detailed information on the 423 British central stations and their equipment.—Supplement to Lond. *Elec. Rev.,* June 8.

South Africa.—Poole.—A table giving statistical data on electricity supply stations of South Africa. The paper gives information on 24 lighting systems and 8 tramway systems. The largest lighting plant is in Kimberley and has a capacity of 3,500 kw.—Lond. *Elec. Rev.,* June 1.

Starting Rheostats.—GEORGES.—A mathematical article on proportioning the steps in a starting rheostat for direct and alternating-current motors by graphical methods.—*Elek. Bahnen,* May 14.

Electrophysics and Magnetism.

Ratio of Electromagnetic and Electrostatic Units.—ROSA AND DORSEY.—An abstract of a Phys. Soc. paper. The ratio of the electromagnetic and electrostatic units is of fundamental importance in Maxwell's electromagnetic theory of light, since this ratio represents the velocity of light. Although this ratio has been determined by various investigators, their results do not give its value to within one part in a thousand, as there are considerable differences in the values obtained. The authors have been carrying out a series of investigations for nearly two years in order to determine its value at least to 1 part in 5,000, and hope to fix its value to within 1 in 10,000. They have employed more than one method and more than one apparatus and have averaged the working conditions in many ways. The mean value of all their measurements is about 299,610 km. per second. —*Phys. Rev.,* June.

Radiothorium.—HAHN.—In a previous paper the author has given an account of the methods of separation and the radioactive properties of a very active substance, called radiothorium, which was prepared from the Ceylon mineral, thorianite. Radiothorium was found to be probably a slowly changing product of thorium—the latter is then supposed to be inactive—which lies between thorium and thorium-X. Radiothorium possesses in an intense degree all the radioactive properties of thorium, for it gives rise to thorium-X, the thorium emanation, and the characteristic active deposit. On account of its great activity radiothorium is a far more suitable source than the feebly active thorium for the investigation of the properties of its radiations. In the present paper the author discusses the range of the alpha particles in air from the active deposit of radiothorium by the methods of scintillation and by an electrical method. He proves that the product, called thorium-B, is complex and consists of two distinct alpha-ray products which have different ranges of ionization in air. He finally investigates the magnetic and electrostatic deflection of the alpha particles from the active deposit. —*Phil. Mag.,* June.

Ionization Produced by Alpha Rays.—BRONSON.—A paper containing an account of an investigation of two entirely distinct but closely related problems. The first is an investigation to determine how the ionization produced by an alpha particle varies near the end of its path. It appears likely that the alpha particle looses its energy very rapidly near the end of its path by collision with the gas molecules and is quickly absorbed by a thickness of air of 7. 2 cm. The second part of the paper is an investigation to prove definitely whether radium-B emits alpha particles which are able to ionize the air for even a short distance. This question is answered by the author in the negative.—*Phil. Mag.,* June.

Discharge Between Parallel Plates.—TOWNSEND.—A mathematical paper with an account of experiments on the field of force in a discharge between parallel plates.—*Phil. Mag.,* June.

Units, Measurements and Instruments.

Color Phenomena in Photometry.—Dow.—An abstract of a British Phys. Soc. paper. The question has often been raised whether it is physiologically possible to compare lights of different colors. The author has found that it is chiefly a matter of practice. A great difficulty arises from the fact that the central portion of the retina is more sensitive to red, and less sensitive to green, than the surrounding portion. Therefore, when we attempt to photometer lights of different color, enormous differences are found as the distance of the eye from the photometer screen is altered, and utterly different results are obtained with different photometers. Curves are given in the paper showing the effect of altering the distance of the eye when an incandescent mantle is compared against a gas standard with the Joly photometer. Differences of 5 per cent can easily be obtained. An experiment was shown at the meeting to demonstrate that the Purkinje phenomenon, generally regarded as a great cause of uncertainty in ordinary work, only becomes noticeable at very small illuminations and with comparatively large fields of view. The Purkinje effect can be physiologically explained by the action of the "rods" and "cones" on the retina. The comparative weakness of the Purkinje effect with small fields can be explained by the fact that the central portion of the eye contains practically no rods, but only cones. The paper also describes experiments to show that flicker photometers seem to be affected by color phenomena, but to a smaller extent than ordinary ones. In any case, whether flicker or an ordinary photometer is adopted, it is necessary to specify the size of the field, the distance of the eye and the order of illumination used, in order to get consistent results.—Lond. *Elec.,* June 8.

Measuring Short Intervals of Time.—DEVAUX-CHARBONNEL.—A note on a French Society paper describing a method of measuring very short intervals of time by means of the discharge of a condenser, for which method a high degree of accuracy is claimed. It is specially adapted for determining the period which elapses while the contact lever of some chronograph apparatus passes over from one contact to another in order to eliminate the error introduced by its appreciable time of action. A condenser of a capacity, *C,* is taken and shunted by a resistance, *R.* One side of the condenser is connected to one pole of a battery and to one terminal of a ballistic galvanometer. The other side is connected to the moving lever and the two contacts are connected to the other terminals of the battery and galvanometer, respectively. When the lever ceases to make contact with stud connected to the battery, the condenser commences to discharge itself through the resistance, R, until the other contact is reached, when the remainder of the charge passes through the ballistic galvanometer. This has been previously calibrated by allowing the whole discharge to pass through it. The fraction of the charge passing through is equal to $e^{-\frac{t}{CR}}$, from which the time (t) can be calculated. Results of observations of the time taken to close a discharge key are given, and are of the order of 0.001 of a second.—Lond. *Elec.,* June 8.

Bifilar Galvanometer.—CAMPBELL.—Before the British Phys. Soc. the author recently exhibited a bifilar galvanometer free from zero creep. For measuring direct currents and voltages of ordinary range (from 0.1 amp. or volt and upwards) moving coil galvanometers with shunts or added resistances are convenient. The usual instruments, however, are affected by gradual displacement of zero (due to elastic set) when a deflection is maintained for some time. This difficulty is overcome by replacing the ordinary torsional suspension by a bifilar system in which the two wires are so far apart that the gravity control quite swamps that due to the torsion of the wires. In the instrument shown the wires were more than 1 cm. apart and the sensitivity with 40 ohms resistance was 400 mm. at 1 metre for 0.001 amp.; this is sufficient for many purposes. The full deflection may be maintained for hours without causing a zero creep of 1 part in 2,000. To attain good damping a very powerful magnet is used.—Lond. *Elec.,* June 8.

Galvanometer.—An abstract of a Phys. Soc. paper of a mathematical nature on some properties of the moving coil galvanometer.—*Phys. Rev.,* June.

Magnetic Action at a Distance on Board Ship.—ENDE AND ARLDT.—Two mathematical communications on this subject.—*Elek. Zeit.,* June 7.

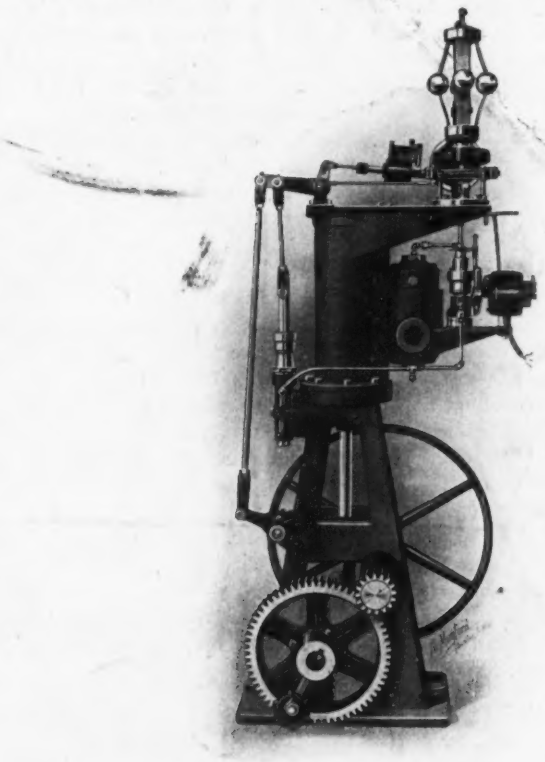
Telegraphy, Telephony and Signals.

Electrolytic Wave Detector.—AUSTIN.—An abstract of a Phys. Soc. paper on the Fessenden electrolytic wave detector. The principal results of the experiments of the author are as follows: When the polarization is complete, enough so that a sensitive galvanometer can be used, a few thousandths volts alternating e.m.f. can be detected. The decrease in the resistance of the cell is approximately proportional to the square of the applied alternating e.m.f. With increasing polarizing e.m.f. the sensitiveness increases to a maximum, after which it remains constant or decreases. Under favorable conditions the cell is found to be about equally sensitive with positive (oxygen) or negative (hydrogen) polarization. At times, however, the action with negative polarization is irregular, the resistance occasionally increasing instead of decreasing. The resistance of the cell is very variable, depending on the polarizing e.m.f. When the polarizing e.m.f. is low, it may be 50,000 ohms or more, while at the point where the polarization is beginning to break down it is sometimes less than 1,000 ohms. In the case of rapid oscillations the effective resistance is modified by the fact that the

cell acts as a condenser. For slow alternations the cell is equally sensitive whether the small electrode is minute or of considerable size. For oscillations of the period usually employed in wireless telegraphy the area should not exceed 0.0003 mm. This difference in action is probably due to the capacity effect of the point. In order to test the hypothesis that heat is a prominent factor in breaking down the polarization resistance at the small electrode, this elestrode was made in the form of a loop of wire through which an alternating heating current could be passed. It is found that the heating of the electrode produces a marked diminution in the resistance of the cell, which indicates that heat is at least one of the factors in the phenomenon.—*Phys. Rev.*, June.

Water Wheel Governors.

The Lombard Governor Company, Ashland, Mass., has recently placed on the market a form of water wheel governor, designated as Type Q, which has been designed for maximum stability and accessibility of the controlling mechanism. As shown in the accompanying illustration, the terminal shaft is placed near the ground with the power cylinder above. The hydraulic cylinder is cast of hard iron, in one piece with the valve chamber and the support for the centrifugal balls. The base frame has the shaft bearings cast integral, so that the heavy stresses which are transmitted cannot possibly cause displacement of any parts. The piston rod is of drawn steel, the rack is forged and cut from open hearth steel and the rack gear is cut from a solid steel bar. The terminal shaft is ground and has



WATER WHEEL GOVERNOR.

the rack gear shrunk on by heat. All relay and regulating valves have renewable parts of hardened steel. The centrifugal and anti-racing mechanisms are of standard form. The hand wheel device has a simple disconnecting clutch for the terminal shaft.

The governor is equipped with a regulating valve and a relay valve, each of which has an adjustable lap. The sensitiveness of the governor may be increased or diminished at will, while it is in operation, by moving the micrometer cap of the regulating valve. The maximum speed of motion of the turbine gates may be varied through a wide range by the relay valve adjustment. When safety permits, the governor may be adjusted to completely open or close the turbine gates within one second. Much slower action is easily obtainable; but it should be generally known that where hydraulic conditions permit, the speed regulation will be better in proportion as the governor moves quicker. Any governor for rapidly varying loads, requiring more than two or three seconds to make its complete stroke, will not give regulation which is good enough for present commercial requirements.

General Electric Tantalum Incandescent Lamps.

The tantalum lamp is now being produced in this country at the General Electric Company's lamp works at Harrison, N. J., and is offered by it to the electrical trade as a lamp giving the lowest consumption of any form of commercial incandescent lamp available to-day. The General Electric tantalum lamp gives an actual consumption of two watts per candle, based on the mean horizontal English Parliamentary Standard, with an average useful life on direct-current circuits of 700 hours or more. When used with the special Holophane pagoda reflectors provided with the lamps, as shown in the accompanying illustration, the downward illumination is increased to one candle per watt or better. Two forms of reflectors are provided: the distributing form and the concentrating form, which gives a more centralized distribution beneath the lamp.

The lamp is at present supplied by the General Electric Company in but one size, having a consumption of 44 watts and giving a mean horizontal rating of 22 cp, equivalent to 25 hefners.

22-CP TANTALUM LAMP.

It is made for voltages of 100 to 130 volts and fitted only with the standard Edison base. It is not recommended for use on alternating-current circuits.

This lamp will enable central stations to reduce the cost of lighting to the customer and therefore meet and resist competition, secure additional desirable business and increase their net earnings. While the first cost of the tantalum lamp is somewhat higher than that of the ordinary carbon filament lamp, this additional cost is saved several times over by the consumer buying electricity at average meter rates given by electric lighting companies. The average life of the lamps is about 750 hours and the value of the new lamp as shown by the saving they secure in consumers' cost of electricity at various rates per kilowatt-hour, is given in the following table:

	Saving in cost of electricity at various rates of 22-cp, 44-watt tantalum lamp.	
Rate per kw-hour cents.	Over present 3.5-watt, 22-cp lamp.	Over present 3.1-watt, 25-cp lamp.
10	$2.47	$1.80
11	2.83	1.98
12	2.97	2.15
13	3.24	2.33
14	3.47	2.51
15	3.72	2.69

It is expected that the new lamp will be supplied to lighting customers on direct-current circuits on a liberal policy as to charges, either on a renewal or on a purchase basis. The lamp possesses several attractive features which should appeal both to the central station man and to his customer. The advertising value of this new lamp as a novelty represents an asset to the lighting company first introducing it to the public in its section. The brilliancy and quality of light of the tantalum lamp is unsurpassed and is predicted to render it most attractive to the consuming public.

On an equal pro-rated useful life basis with present 16-cp, 3.1-watt lamps, central stations now supplying free renewals could afford to supply tantalum lamps at a low figure without adding to their present lamp renewal costs. Central stations now furnishing free renewals of 3.5-watt lamps could similarly supply the tantalum lamp at a little higher figure without increasing their renewal costs. In any case the consumer, as shown by the foregoing table, would save several times the value of the charges of the tantalum lamp.

Riveted Frame Induction Motors.

The Stanley-G. I. Electric Manufacturing Company, Pittsfield, Mass., has just placed upon the market a type of polyphase induction motor which possesses the distinguishing characteristic of having the laminated iron core of the stator freely exposed to the air around its entire periphery. The frame is held together by means of a riveted construction which has rendered it possible to do away with the cast iron ribs which are used with motors of larger sizes. In this way it is unnecessary to use end castings of greater diameter than the laminations, and thus the dimensions and weights of the motors are greatly reduced. The design and construction are such that the assembled structure is made rigid and incapable of distortion. The feet of the motor, which are a part of the end-frame casting, are spread well apart so as to give the motor a substantial base.

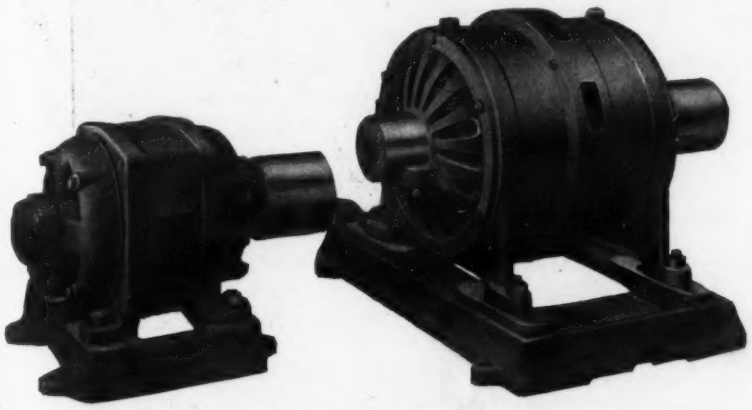


FIG. 1.—NEW MOTOR AND OLD STANLEY MOTOR OF TYPE BUILT 15 YEARS AGO.

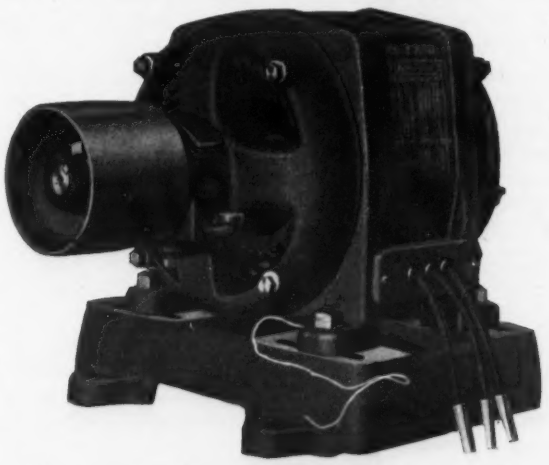


FIG. 2.—THREE-QUARTER VIEW POLYPHASE MOTOR.

The advantages of the design described above are apparent. The motors are light in weight and therefore easily handled, and may be supported for operation in places where heavier motors could not be used. The small dimensions are in many cases of great advantage. This is particularly true where the motor is to be direct connected to or built into a machine which it is to drive. Particular attention is called to the fact that this design secures a motor of small dimensions and light weight, not so much by a reduction of the motor proper as by the curtailment of the material which is of no active value. Every particle of the material included is put to valuable use.

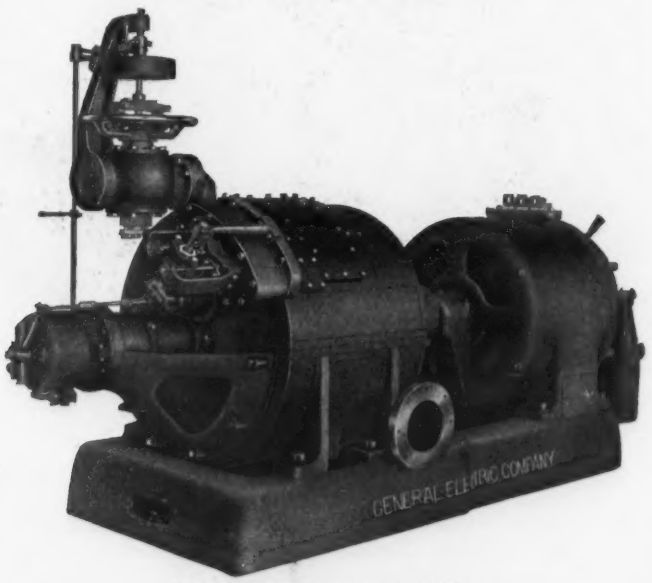
FIG. 3.—DISSEMBLED VIEW OF 3-HP MOTOR.

Fig. 1 illustrates a motor of this new type side by side with an early Stanley motor of higher speed and the same output, which was on the market fifteen years ago. The progress in induction motor engineering cannot be more strikingly illustrated, especially when it is remembered that the present motor excels the old type in points of efficiency and general performance to as marked a degree as in size and weight.

These motors are built in sizes from 1 to 75 hp, and for two-phase or three-phase current. The secondary is in each case of the squirrel-cage type, the simple and indestructible character of which is well known. No switches or moving electrical contacts whatever are used, so that the motor is unaffected by dust or dirt. Furthermore, there is no danger from electric sparks.

Small Curtis Steam Turbine.

The accompanying illustration shows a 75-kw Curtis steam turbine generating set, of a type adapted for train-lighting, as an exciter in generating stations and for auxiliary power of all kinds where small space and quiet running, as well as minimum expense for installation, are of importance. Machines are built for these purposes in sizes from 15 kw to 300 kw, for operating either condensing or non-condensing at pressures ranging from 80 to 200 lbs. in the smaller sizes and from 100 to 200 lbs. in the larger types, without reducing valve and at any



SMALL CURTIS STEAM TURBINE.

degree of superheat up to about 200° F. without danger of injury.

In these smaller sizes of turbines the bearings are supplied with oil by the usual oil rings and wells of ample proportions. Since the system is closed, there is no waste of oil from spattering or other causes. No internal lubrication is necessary, and as a result the exhaust steam can be used in heating systems or in manufacturing processes, as it is entirely free from oil.

The speed of the turbine is held constant by a centrifugal governor which controls the steam supply entering the turbine. A uniform speed is obtained irrespective of load conditions. In addition to the regular governor an emergency governor is supplied which shuts off the steam, if for any reason the speed should rise a certain percentage above that fixed as normal. This entirely eliminates any danger of excessive speeds.

The generators in these turbine sets gain indirectly in compactness because of the higher operating speeds as compared with generators of the engine driven type, and the cylindrical design of the turbine suits exactly the compact, well proportioned electrical unit.

From their compactness and absence of vibration, the small Curtis steam turbine sets have found a wide field in electrical train lighting, mounted either on the locomotive or in the baggage car, as exciter sets in power houses, and for small power and lighting installations. Being easily and quickly located in an odd corner, they have been found exceptionally well adapted for auxiliary units in manufacturing establishments. In the smaller sizes the set makes an ideal unit for marine work.

Improvements in Water-Tight Floors for Central Stations.

In laying out storage battery rooms special attention must be given to the drainage, the ventilation of the room and to the material used in the construction, owing to the presence of free sulphuric acid in the air caused by the gassing of the batteries. Cement floors are not suitable for battery rooms because of the chemical action of sulphuric acid on the cement; but inasmuch as cement enters largely in the construction of the floors of nearly all modern fire-proof structures, it cannot be readily eliminated,

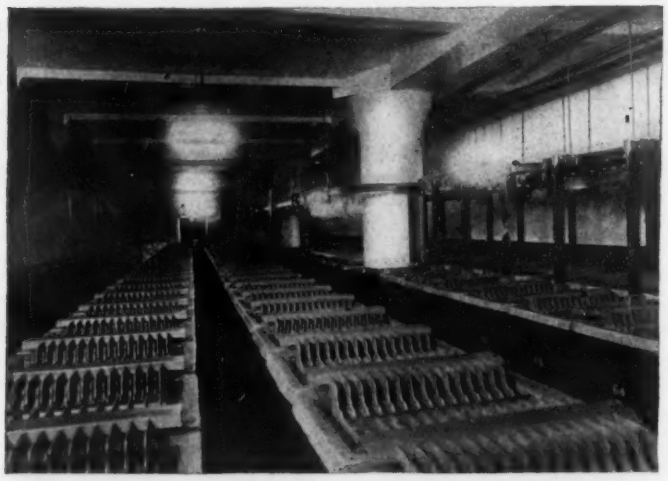


FIG. 1.—BATTERY ROOM, DUANE STREET STATION OF THE NEW YORK EDISON CO.

so that some means of protecting it must be used. The usual method of laying battery room floors is first to place a layer of concrete over the arches and floor beams and then finish with a coat of cement. When this is dry the floor is thoroughly mopped with hot asphalt and tile or vitrified brick is then laid with 1/16-in. joints which are filled with hot asphalt so as to make the floor both acid and water-proof. It is characteristic of asphalt, however, to become soft in warm weather and to be depressed under the weight of the batteries which causes the material to ooze up between the tile or other paving material. Moreover, the commercial asphalt is so adulterated with tar and pitch that it soon becomes useless for the purpose intended, if it is not so from the beginning.

A compound which is coming into very general use for this purpose is known as "Hydrex," and in combination with "Hydrex felt," has been successfully employed on the battery room floors of some large central stations. The compound is melted and mopped on hot to the floor and between two layers of the felt, the latter being again mopped before the tile or brick is laid. The joints of the paving material are run with the compound, and in this respect the procedure is similar to that described above, the only difference being in the material applied, depending primarily upon specially made felt. The Hydrex compound is said to possess superior acid-resisting qualities and does not become soft at the moderate temperatures which render asphalt soft, so that it does not ooze, nor place the floor out of alignment. There is considerable knack in applying the substance so as to properly drain the floor and the walking surface above it. The exposed surfaces in the room and the conduits for carrying off the gases are painted with Hydrex cement, a liquid having the consistency of thick black paint, which is applied with a brush. Iron, wood or any other

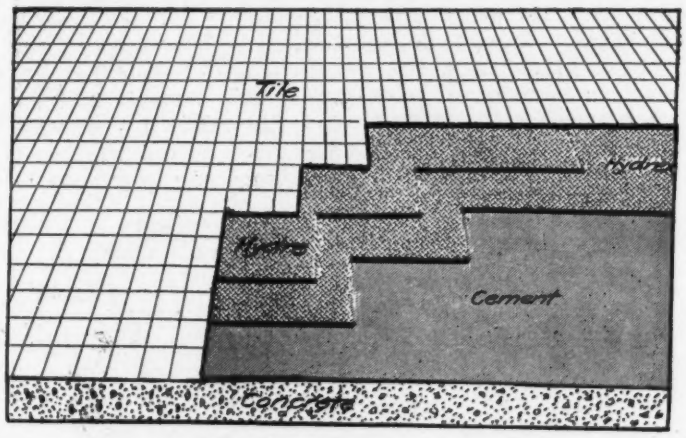


FIG. 2.—APPLICATION OF "HYDREX" FELT.

substance heavily coated with this cement is said to be rendered acid-resisting.

The felt used is very tenacious and pliable and possesses excellent water-proofing qualities, being absolutely impervious to water. The felt was originally made for underground water-proofing and to resist the severe conditions of such work. It has been extensively used in water-proofing foundations of power houses and in water pressure work. The felt also possesses excellent insulating qualities, and besides being used under generators to insulate them from the ground where this is desirable, it has also been adopted for third rail insulation on some of the large trunk lines. The ordinary tar or asphalt papers which are not of themselves water-proof, are not suitable for such work, since they soon dry out and disintegrate when exposed to the atmosphere. There has always been a demand for a felt having the nature of a membrane which in addition to being saturated like the ordinary so-called water-proof papers was at the same time treated by some additional process, so as to be in itself impervious to air and water. This would mean a felt which if shaped into a box and filled with water would still be durable and elastic and not let a drop of water pass through.

By means of the construction above outlined, battery rooms may be placed on the upper floors of stations, leaving the basement free for all cable runs, high-tension bus-bars, air chambers, rheostats, resistances, etc., and permitting a well-designed drainage system which would be impractical were the battery in the basement as is often the case. An impervious felt being a fair insulator, it may be used in a number of places where a cheap insulating substance is desired. The felt, which is made by the Hydrex Felt & Engineering Company, of New York City, is now being used in water-proofing the Pennsylvania tunnels under New York. The increasing use of concrete, especially in the foundations of modern power houses, emphasizes the necessity of a reliable material and method for water-proofing. The chief requisite in a water-proofing substance is elasticity, which will not crack with any settling or cracking of the masonry. The felt is also used in the roofs of power houses and for engine foundations.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Wholesale trade was quieter, but on the whole very satisfactory conditions prevail. Relief from drought in many important farming sections restored prospects of bountiful harvests, and the business of the nation maintained a volume that is exceptionally heavy for the season. Some evidences of conservatism regarding production beyond assured demands are noted, but in many of the leading industries contracts have been placed for the entire ouput during the remainder of the year, while steel mills are booked well into 1907. One of the features of the week was the settlement of the coal mining troubles in Ohio. Railway earnings thus far available for June show a gain of 10.5 per cent over last year's figures, and foreign commerce at the port of New York exceeds the volume in 1905 by $5,791,920 as to imports and $2,515,542 as to exports. Manufacturers in a number of lines, notably hardware, fine cottons and shoes, report orders booked ahead to a greater extent than is usual at this time. One of the events of the week in the iron market was the dissolution of the so-called gentlemen's agreement to maintain prices on Southern foundry pig iron and the booking of some orders at a reduction of $1 per ton. Outside of the competitive zone, however, the tendency is to maintain the firmness of the past week. The steel-making irons are higher and positively scarce, while Bessemer and forging steel billets and light steel rails have been advanced 50 cents to $1 per ton. Incidentally, makers of cast-iron pipe are being offered premiums of $1 to $2 per ton for early deliveries, and there is talk of raising sheet bars. Demand for finished material is heavy, while the steel-rail mills have added to their already heavy commitments for 1906 and 1907. Wire products display more activity than is usual at this season, and sales of 100,000 tons of steel bars have been made in the Chicago district. Copper is dull and prices are easier. For the first time since May 11 copper prices were reduced, the reduction amounting to ⅛ to 3-16 cent. This was on indifferent demand, with a desire on the part of some holders to work off a portion of their holdings. The closing quotations were 18 13/16 for Lake, 18½ for electrolytic, and 18 5/16 for casting stock. *Bradstreet's* reports 173 business failures last week. This is three more than those of the week previous; also of the corresponding week last year.

CONDITION OF COPPER MARKET.—In discussing the recent situation, *Copper Gossip*, the bulletin of the National Conduit & Cable Company, says: "It is the consensus of opinion that copper will be in good demand, not only until the end of 1906, but that the tendency is for another year of great activity in 1907. A great deal depends upon the character of this year's crops. If they turn out as favorable as last season's business will undoubtedly feel the stimulating effect of a splendid agricultural situation. With the many encouraging features noticed at all trade centers there is abundant reason to regard the outlook optimistically. Developments in electrical quarters all point to an immense demand on account of new work from this source. The wire consuming industry is feeling the expansion in this field to an extraordinary degree, and with the prospects in sight an enormous tonnage of copper will be required for electrical equipments alone. Cables, miscellaneous wire products, motors, dynamos and telephone installations are all using up steadily increasing quantities of copper. The end it not yet, and what with the electrification of the railroads begun, the extent to which electrical improvements will be spread will eventually be on a tremendous scale. Electrical demand for copper will, therefore, continue to be a leading factor and a very marked feature in the copper situation. There are many interesting phases in connection with the copper market, but the growing demand for the wider introduction of electrical appliances is one of the most vital in maintaining the unusual strength now seen in the copper trade. Domestic consumption is estimated at the rate of 60,000,000 pounds of copper per month, and on this basis the quantity available for export is confined to proportionately narrower limits than in former years. Latest transactions include sales for October and November, at prevailing prices."

ALLIS-CHALMERS TURBO-GENERATOR FOR MERIDEN.—The Meriden (Conn.) Electric Light Company has recently placed its order with the Allis-Chalmers Company, of Milwaukee, for a 500-kw turbo-generator unit to be installed at the power house in Meriden late in the fall for lighting and power purposes. In additon to the turbine and generator proper, the Allis-Chalmers Company will furnish a structural steel foundation frame and a surface condenser with 2,000 sq. ft. of cooling surface, including centrifugal circulating pumps, air pumps, etc. The turbo-generator is the standard 500-kw construction, wound for 60 cycles, 2,300 volts, two-phase, with a steam pressure of 125 lbs. per square inch. The turbine is direct-connected to the revolving field of the generator. The turbine and alternator rotors, each carried on two bearings, will rest on a continuous bed plate, which is provided with suitable slides to allow for the expansion and contraction of the turbine cylinder, and in order to preserve the alignment of the entire unit. Units simlar to this one are now on order for the city of Jacksonville, Fla., the Western United Gas & Electric Company, of Aurora, Ill., and the Muncie Electric Light Company, of Muncie, Ind. Both turbine and alternator are the products of the Allis-Chalmers Company. The alternator will be built at the company's electrical works, Cincinnati, and the turbine will be built in the West Allis works.

ORDERS FOR VOLTAX.—The Public Service Corporation of Aurora, Ind., has recently placed a large order with the Electric Cable Company, of 17 Battery Place, New York, for Voltax, the new insulating compound, which it will use for purposes of waterproofing. The Electric Cable Company has recently sold a large quantity of Voltax to Paul Smith's Hotel Company as a waterproof paint for use on telegraph and trolley poles and fence posts on its property in the Adirondacks. The Electric Cable Company has been selling this compound extensively for this purpose. The Brass Goods Manufacturing Company, of Brooklyn, New York, has placed a large order with the Electric Cable Company for Voltax for waterproofing concrete floors.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, of Rochester, N. Y., reports having closed contracts for switchboards for the following places: Volant, Pa.; Chicago, Ill.; Dispatch, N. Y.; Sodus, N. Y.; Old Fort, N. C.; Walnut, Kans.; Herkimer, N. Y.; Syracuse, N. Y.; Leon, Ia.; Seattle, Wash. It has also closed contracts with the Metropolitan West Side Elevated Railway Company, Chicago, Ill., and the Cuban Eastern Railway Company, New York.

THE VALLEY FORGE SYSTEM, of railroads, with offices on the twenty-first floor, Land Title Building, Philadelphia, is to build a third-rail, low grade, private right of way line without grade crossings, from Philadelphia to Phoenixville, Pa. Much of the right of way is already acquired. Mr. L. Knowles Perot is president; Marshall S. Lynch, chief of engineers; G. U. G. Holman, electrical engineer, and Wm. J. Phillips, Jr., manager of right of way.

LARGE CANADIAN CONTRACT.—Westinghouse, Church, Kerr & Company have been retained by the Grand Trunk Railway Company, of Canada, as engineers to construct in Toronto one of the most modern and up-to-date terminals in the Dominion of Canada. This new station is to cost over $2,000,000 and will have most complete facilities for the freight and passenger transportation of the Grand Trunk and the Canadian Pacific railroads.

MILL AND PACKING HOUSE.—Libby, McNeil, Libby Company, of Union Stock Yards, Chicago, has ordered one 200-kw generator and eight motors, ranging from 10 to 35 hp, from the Crocker-Wheeler Company, of Ampere, N. J. The Ipswich Mills, of Ipswich, Mass., have recently ordered from the Crocker-Wheeler Company one 250-volt generator to furnish light for their building.

W. M. SHEEHAN & COMPANY, 136 Liberty Street, New York City, are installing an addition to the present plant at the State Training School for Women at Hudson, N. Y., and in addition are installing twelve 40-hp motors on brick machines at the yard of the Bartlett Brick Company, at Hudson, N. Y.

GENERATOR FOR MILLER LOCK COMPANY.—The Crocker-Wheeler Company, of Ampere, N. J., has received an order from the Miller Lock Company, of Philadelphia, Pa., for a 250-kw, 250-volt, engine-type generator to furnish power for running various motor-driven machinery.

INCREASE OF PLANTS.—The Alliance (O.) Gas & Electric Company expects to increase its power plant, putting in new boilers, and proposes also to adopt steam turbines.

BELL TELEPHONE PROSPERITY.—Figures of recent Bell telephone output have been given in these columns. The output statement of the American Telephone & Telegraph Company for May, remarks the *Wall Street Journal*, surpassed all previous records in both gross and net output. The best previous record was for April, 1906. The May gross output, for the second month in the history of the company, exceeded the 200,000 mark. These record-breaking results are the reflection of the aggressive policy of the company, of the general business prosperity of the country, and of the summer demand for telephones, which usually begins about the middle of May. The replacing of the telephone service destroyed by the San Francisco fire is also partly accountable for the large output. The company lost over 35,000 stations by the fire, and several heavy shipments of instruments West have already been made. The following table shows the gross and net outputs for the months of January, February, March, April and May, 1906, together with those of the corresponding periods of 1905:

	Gross		Net	
	1906.	1905.	1906.	1905.
January	176,607	130,634	113,383	92,934
February	161,775	134,301	112,933	86,724
March	188,102	169,159	121,506	121,514
April	206,557	174,207	141,200	129,226
May	211,573	168,764	152,230	115,552
Total	944,614	777,065	641,252	545,950
Increase	167,549	268,693	95,302	240,624

NEW YORK NAVY YARD TURBINES.—The Navy Department in its recent power extensions to the New York Navy Yard has, through its Bureau of Yards and Docks, adopted Westinghouse-Parsons steam turbines, which will be installed in Building No. 41. The present installation will comprise two 500-kw units operating under 150 pounds steam pressure, 28-inch vacuum and on superheated steam at 100 degrees Fah. The power plant supplies three-phase alternating current at 2,300 volts and 60 cycle frequency to the machine shops and dry docks and for other general purposes about the New York yards, including lighting of buildings. The boilers will be of the Stirling water tube type, with Foster internal superheaters. Worthington surface condensers will be used. This will make the second turbine plant that the Westinghouse Machine Company has installed for the Navy Department, the first one being at the Boston Navy Yard, where the turbines have been giving very good service.

TELEPHONY IN SAN FRANCISCO.—The Independent Home Telephone Company of that city, immediately upon the granting of the franchise (for which it paid the city $25,000, and, in addition, donated $75,000 to the relief fund), signed contracts with the Automatic Electric Company, of Chicago, for automatic telephone equipment with immediate provision for 10,000 lines. Work will be begun as soon as conditions in the stricken city will permit. It is impossible to say at this time how soon the exchange will be in operation. The time is auspicious for the entrance of the independents into San Francisco. The partial destruction of the Bell equipment there and the delays of rebuilding should, it is thought, make the road of the independents much easier to travel.

STEAM TURBINES FOR D. L. & W.—The Delaware Lackawanna & Western R. R. Company has contracted with the Westinghouse Machine Company for two Westinghouse-Parsons steam turbines to be installed in its new passenger terminal at Hoboken, N. J. The turbines will operate under a steam pressure of 140 pounds, 28-inch vacuum and moderate superheat, driving 550-kw, three-phase, 60-cycle Westinghouse generators of the rotating field enclosed turbo type. These machines will supply current to the station and yards. Internal superheaters will be used, while the condensing system will be Worthington barometric. Babcock & Wilcox boilers will supply steam, using small anthracite coal.

THE DERBY GAS COMPANY, Derby, Conn., has retained W. S. Barstow & Company, 56 Pine Street, New York, as engineers in making extensive additions to its electric power plant and distributing system. The present plant will be remodeled to conform with the new installations. When the plant is completed it will be one of the most modern of its kind and will include some interesting departures from current practice.

MONTREAL RAILWAY POWER HOUSE.—The Montreal Street Railway Company is about to have constructed a large new steam power house. It will be equipped to have a capacity of about 22,000 hp. The plant, which will be of modern construction in all particulars, will be built by the Canadian branch of J. G. White & Co.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was depressed, general declines having occurred in pool stocks, such as Reading, as well as in the United States Steel shares and specialties, like Interborough-Metropolitan. The latter, which had been supported at 50, broke violently early in the week and dropped at one time to 41. The cause of this decline was inexplicable. There was a general rally at the close of the week. The telegraph stocks, of the electrics, are the only ones that closed with gains, Western Union closing at 92 ex div., an advance of ¼ point, and American Telegraph & Cable at 91, which is a like gain. Allis-Chalmers common closed at 21, and preferred at 56¼, the latter being a decline of ¾ point. General Electric is off a fraction, closing at 165¾, and Westinghouse dropped 3 points, the last quotation being 158. American Locomotive common closed at 69, and preferred at 115. Among the tractions, Brooklyn Rapid Transit suffered a net loss of 2 points, and Metropolitan Street Railway 3, the closing prices being 78 and 110, respectively. Interborough-Metropolitan common closed at 43, which is a net decline of 7 points, and preferred at 78½, a loss of 4½ points. The market for outside securities was irregular, following the course of the main market. The following are the closing quotations of June 26:

NEW YORK

	June 19	June 26		June 19	June 26
Allis-Chalmers Co.	20⅞	19⅝	General Electric	166	163
Allis.Chalmers Co. pfd.	57½	53⅜	Hudson River Tel.	...	...
American Dist. Tel.	30	30	Interborough Rap. Tran.	...	...
American Locomotive	71⅜	68¼	Mackay Cos.	74¾	73
American Locomotive pfd.	115	113¾	Mackay Cos. pfd.	78	72¾
American Tel. & Cable.	91	90	Marconi Tel.	...	...
American Tel. & Tel.	137	137	Metropolitan St. Ry.	104	*112
Brooklyn Rapid Transit.	80⅛	77⅝	N. Y. & N. J. Tel.	...	...
Electric Boat	25	18	Western Union Tel.	92⅛	91⅛
Electric Boat pfd	70	65	Westinghouse com.	156	155
Electric Vehicle	10	10	Westinghouse pfd.	...	...
Electric Vehicle pfd.	16	16			

BOSTON

	June 19	June 26		June 19	June 26
American Tel. & Tel.	138¼	137	Mass. Elec. Ry. pfd	70	88
Cumberland Telephone.	...	...	Mexican Telephone	3⅜	...
Edison Elec. Illum.	246	241	New England Telephone	135	130¾
General Electric	172½	...	Western Tel. & Tel.	...	...
Mass. Elec. Ry.	20¼	19¼	Western Tel. & Tel. pfd.	92	...

PHILADELPHIA

	June 19	June 26		June 19	June 26
American Railways	51⅜	51½	Phila. Electric	8¼	8⅛
Elec. Co. of America	11¼	11¾	Phila. Rapid Trans.	24⅛	24¼
Elec. Storage Battery	72	70	Phila. Traction	98¾	...
Elec. Storage Battery pfd.	...	..			

CHICAGO

	June 19	June 26		June 19	June 26
Chicago City Ry.	170	167½	National Carbon	83	85
Chicago Edison	...	145	National Carbon pfd.	119	*117
Chicago Subway	..	52⅝	Union Traction	...	...
Chicago Tel. Co.	...	117	Union Traction pfd	...	...
Metropolitan Elev. com.	26	26			

* Asked

STONE & WEBSTER ENGINEERING CORPORATION.—An engineering and construction company, with a fully paid-in cash capital of $250,000, has been organized by Stone & Webster, under the laws of Massachusetts, to engage in a general engineering and construction business in connection with large undertakings. The engineering corporation will take over the engineering part of the business of Stone & Webster, which was originally the important part of their general business. Stone & Webster, some 16 years ago in Boston, were among the first to enter the field of electrical development as electrical engineers and experts, the business soon reaching large proportions. During the last few years, however, on account of other important interests of the firm, their efforts along these lines have been almost exclusively devoted to the "executive" requirements of the various companies under their management. As the firm desires to devote its time and energies to financial affairs and the management and development of the numerous properties which it operates, it has formed the Stone & Webster Engineering Corporation, the personnel of which will largely consist of men who have been associated with the firm for years in connection with the engineering and construction side of their business. In addition, arrangements have been made to associate with the new company engineers of prominence in their various lines, with the idea of placing it in a position to undertake engineering and construction work of importance throughout the country. All the stock of the company has been taken by Stone & Webster and their associates.

MEXICAN TELEGRAPH.—The Mexican Telegraph Company for the June quarter shows a gross of $170,500 as compared with $135,000 last year, a net of $142,500 and a total surplus of $2,193,734.

DIVIDENDS.—The directors of the Electric Storage Battery Company have declared a dividend of 1¼ per cent, both on the common and preferred stocks, payable July 2. The American Telephone & Telegraph directors have declared the regular quarterly dividend of 1½ per cent and an extra dividend of ¾ per cent, payable July 15. The directors of the Union Switch & Signal Company have declared the regular quarterly dividends of 2 per cent on the common stock and 2½ per cent on the preferred stock, both payable July 10. The directors of the Hall Signal Company have declared the regular quarterly dividend of 1½ per cent on the common stock, payable July 2, to stock of record June 23. The directors of the New York Air Brake Company have declared the regular quarterly dividend of 2 per cent, payable July 18. The Bell Telephone Company of Philadelphia directors have declared the regular quarterly dividend of ½ per cent, payable July 16. The directors of the Chicago Telephone Company have declared the regular quarterly dividend of 2½ per cent, payable June 30. The Detroit United Railway Company directors have declared the usual quarterly dividend of 1¼ per cent on the capital stock. The directors of the Central & South American Telegraph Company and the Mexican Telegraph Company have declared the regular quarterly dividends of 1½ and 2½ per cent, respectively. The Washington Water Power Company has declared a quarterly dividend of 1¾ per cent, payable July 2. The directors of the Westinghouse Electric & Manufacturing Company have declared the regular quarterly dividend of 2½ per cent upon the preferred assenting and non-assenting stocks, payable July 10. The directors of the Memphis Street Railway have declared a semi-annual dividend of 2½ per cent on the preferred stock. The directors of the Duluth Edison Electric Company have declared a dividend of 1½ per cent on the preferred stock, payable July 1. The directors of the Tri-City Railway & Light Company have declared a dividend of 1½ per cent on the preferred stock, payable July 2. The directors of the New Orleans Railway & Light Company have declared the regular preferred quarterly dividend of 1¼ per cent, payable July 16. The dividend of 1¼ per cent declared by the directors of the Detroit United earlier in the week is payable August 1. The Manchester Traction, Light & Power Company has declared a regular quarterly dividend of 1½ per cent and 1 per cent extra, payable July 16. The directors of the United Railways of St. Louis have declared the regular quarterly dividend of 1¼ per cent on the preferred stock, payable July 10. The Omaha Electric Light & Power Company has declared a semi-annual dividend of $2.50 per share on the preferred stock, payable August 1. The directors of the E. W. Bliss Company have declared the regular quarterly dividend of 2 per cent on the preferred stock and 2½ per cent on the common stock, payable July 2. The directors of Manning, Maxwell & Moore, incorporated, have declared a regular quarterly dividend of 1½ per cent on the $5,000,000 capital stock, payable July 2.

THE BALTIMORE CONSOLIDATION.—The plan for the consolidation of the Consolidated Gas Company with the Consolidated Gas, Electric Light & Power Company is made public. The latter company owns 61 per cent of the stock of the former and there is to be a scaling down of capital. The minority stockholders of the gas company are offered 80 per cent in new preferred and 50 per cent in common for their holdings, while the preferred stockholders of the Consolidated Gas, Electric Light & Power Company are offered 50 per cent in new preferred and 40 per cent in new common. The common stockholders are offered 30 per cent in new common, while the holders of the prior lien stock, of which there is only $700,000 outstanding, are to receive 100 per cent. A syndicate has been formed by the Continental Trust Company, of Baltimore, which offers $83 a share for the stock of the gas company, and proposes to place all acquired in the consolidation. The company has also formed a syndicate, which has underwritten the entire issue of common stock of the new company at 40 per cent on the par value, and every stockholder of both companies has the option of either accepting the new common stock of the Consolidated Company, or, in lieu thereof, $40 a share in cash. The stockholders of the gas company are offered the further option to exchange the new preferred stock receivable by them for the 4½ per cent general mortgage bonds, part of the $7,102,000 of such bonds heretofore issued by the power company on the basis of exchange of bonds at par for the preferred stock at par, provided notice of such election is served on the trust company not later than June 28.

ALLIS-CHALMERS BONDS.—The Allis-Chalmers Company is to offer to its stockholders $12,000,000 first mortgage ten-thirty-year sinking fund bonds, an issue recently decided upon by the directors for the financing of the additions to the company's plant at Milwaukee and to pay for the Bullock Electrical Works at Cincinnati, as well as to provide working capital for the increased business. The stockholders' privilege to subscribe is at the rate of 80 and interest pro rata, according to their holdings. The bonds, which are dated July 1, will be redeemable after ten years at 110 and interest. The sinking fund provides for the purchase of the bonds in the open market after five years at a maximum of 110, and, if carried out, should retire the bonds by maturity. The bonds will be underwritten by a syndicate managed by Shearson, Hammill & Company.

KEY WEST CONSOLIDATION.—Stone & Webster, of Boston, have purchased the Key West Electric Company, which does the entire electric railway and lighting business of Key West, Fla. The company will retire all the outstanding securities and the new capitalization will be as follows: Bonds, first mortgage, 50-year, 5 per cent gold, to be authorized, $1,000,000; to be issued, $450,000; preferred stock, 6 per cent non-cumulative, to be authorized and issued, $230,000; common stock, to be authorized and issued, $500,000. New money will be provided to re-equip the power station, to purchase cars and equipment, to extend the lighting system, to develop the gas business under the franchise owned by the company, and to put the entire property in the best operating condition. The present street railway mileage is five miles.

UNITED STATES TELEPHONE STOCK INCREASE.—The capital stock of the United States Telephone Company was increased from $2,500,000 to $5,000,000 at a meeting of stockholders in Cleveland. This was deemed advisable in order to place the company in position to increase its holdings and enlarge its scope in accordance with plans already decided upon. The board of directors was increased to fifteen by the election of six new members who represent the new interests which have recently acquired large holdings in the company. The new directors are H. C. Stifle and A. H. Bower, of St. Louis; S. Hopkins, Columbus; A. B. Taylor, Elyria; Clarence Brown, of Toledo, and Herbert Wright, of Cleveland. The directors of the company declared a dividend of ¾ of 1 per cent on common and 1½ per cent on preferred, payable July 10.

NEW ENGLAND TELEPHONE.—The New England Telephone & Telegraph Company have offered $3,965,500 of new capital stock to shareholders at par in proportion to their respective holdings. Each stockholder of record June 20, 1906. will be entitled to the new stock in the ratio of one share for each seven of present holdings. The rights to subscribe expire July 18, 1906, and all subscriptions and assignments of rights must be filed with the secretary of the company by the latter date. Payments for the new stock must be made, one-half by August 20, 1906, and the balance Feb. 20, 1907. The proceeds of the issue will be used to provide funds for extension of the property and business of the company and for payment of bonds due in 1907.

LONG ISLAND TROLLEY BONDS.—The New York & Queens County Railroad, which runs from Long Island City, opposite the Thirty-fourth Street Ferry, to Flushing, Corona, Jamaica and other points, has applied to the State Railway Commissioners for permission to issue $10,000,000 bonds on a first and refunding mortgage. Mr. Noel Gale, of Strong & Cadwalader, explained that the object of the loan was to liquidate some outstanding indebtedness and to furnish funds for improving the road and providing more cars and power. The Commissioners directed Mr. C. R. Barnes, their electrical expert, to investigate conditions on the road and to make a report.

INTERSTATE TELEPHONE RECEIVERSHIP.—The referee in the Interstate Telephone receivership matter has made his report to the New Jersey Court of Chancery at Trenton. He reports there is due on the mortgage given to secure the bonds the sum of $2,054,083, and that the property of the company should be sold as a whole. The Trenton Trust & Safe Deposit Company was the trustee, but recently resigned, and Carroll Robbins was elected trustee. Robbins brought suit to have the mortgage foreclosed to satisfy the bondholders.

NEW ORLEANS BONDS.—The $13,643,000 of the general mortgage 4½ per cent bonds of the New Orleans Railway & Light Co. have been issued, to satisfy obligations and for general corporate purposes, $13,357,000, and for acquisitions, extensions, betterments, $286,000. The New Orleans Railway & Light Co. owns about 190 miles of track, and operates 500 cars. The gas franchise is perpetual and exclusive until 1925. The electric light franchise is perpetual, and the street railway franchises are generally for from thirty to fifty years.

SOUTH AMERICAN TELEGRAPHS.—The Central & South American Telegraph Company shows for the June quarter a gross of $353,000 as compared with $300,000 last year and net of $246,000 against $194,500. The surplus is $1,656,749.

GENERAL NEWS.

Construction News.

SYLACAUGA, ALA.—The Council has decided to issue $16,000 bonds for improving the water works and electric light plant.

LANGLEY, ARK.—D. A. Allen, of Altus, Ark., president of the Southern Power & Development Company, writes that it is proposed to build a dam 3 feet wide at top, 235 feet at bottom and 50 feet high, for furnishing electric power for operating saw mills and lighting plants.

LITTLE ROCK, ARK.—The City Council has granted John G. Vogel a 50-year franchise for an electric light, heat and power plant, and also embodied in the ordinance a contract for the lighting of the streets of the city with 60 electric lamps, for which the city agrees to pay during the life of franchise $600 per month.

HARRISBURG, ARK.—The Harrisburg Light & Power Company has been merged with the Royal Handle Manufacturing Company, and it is proposed to consolidate the two plants in the near future. The officials for the new company are Morris Hayutin, president; J. J. Mardis, vice-president; T. B. Steele, secretary and treasurer.

GARDEN GROVE, CAL.—The Edison Electric Company will put in a power plant for the Garden Grove Irrigation Company.

LOS ANGELES, CAL.—Property owners on East Seventh Street have raised $75,000 for the construction of an electric railway.

LOMPOC, CAL.—Messrs. Woods and Lewis, of Los Angeles, are interested in the construction of an electric light plant at Lompoc.

CHICO, CAL.—The Northern Electric Company has purchased a site at Second and Main Streets, on which it will erect a building at a cost of $75,000.

OAKLAND, CAL.—The Oakland Gas, Light & Heat Company has been awarded the contract for lighting the streets and public buildings for the year 1906-1907. The price paid for arc lamps is $75 per year.

STOCKTON, CAL.—The City Council has passed an ordinance calling for an election on July 31, to vote on issuing bonds for $764,000 for municipal improvements, including the building of an electric lighting plant.

UKIAH, CAL.—The Snow Mountain Power Company has been granted a franchise by the Board of Supervisors to erect and maintain a transmission line to supply electricity for light, heat and power, and to erect telegraph and telephone lines along and over certain highways in Mendicino County.

REDDING, CAL.—The Northern California Power Company has leased the power plant on Battle Creek, of the Battle Creek Power Company, for a period of fifty years, at an annual rental of $500. By the lease the Northern California Power Company assumes all existing contracts and is to pay at maturity the $1,000,000 bonds issued by the Mercantile Trust Company.

SAN FRANCISCO, CAL.—The work of lighting the streets in the burned district has been started; according to the plans now being made, the greater part of this area, which has been intotal darkness, will soon be lighted by electricity. After the fire the United Railroads of San Francisco voluntarily offered to furnish the city, free of charge, lamps for Market and Sutter Streets; the company will supply poles of a special design to be selected by the city. This will be done as soon as the work of re-establishing its street car service is completed.

ROCKY FORD, COL.—E. L. McKelvey, city clerk, writes that the Weber Gas & Gasoline Engine Company, of Kansas City, Mo., has secured the contract for two 100-hp gas producers, two 100-hp gas producer engines, a triple single-acting high-duty pump and a 50-kw direct-current generator for $16,553.

BOULDER, COL.—Westinghouse, Church, Kerr & Company have been engaged by the Northern Colorado Power Company as engineers and constructors of its large power and transmission plant, which is to be built in this place. The equipment for the system will be installed by the Westinghouse Electric & Manufacturing Company. The plant will cost $1,000,000 and will supply a number of towns in Colorado and Wyoming with electricity for lighting and for the operation of street railways.

NORWALK, CONN.—The Reed & Volk Electrical Company is installing an electric lighting plant at Midbrook, the residence of Mr. Samuel R. Weed in Brookside.

STAFFORD SPRINGS, CONN.—Smith & Cooley have recently installed a new electric plant and are now operating their plant by electricity. The Rhode Island Company will soon install an electric plant and use electricity for power.

COSCOB, CONN.—The Westinghouse Electric Company has installed in the power house of the New York, New Haven & Hartford Railroad Company the first of the units which are to supply the electricity for the operation of the new electrical service from Stamford to New York. The unit installed is of 3,000 hp. It is expected that the capacity of the power house, when completed, will be 12,500 hp. Other units will be installed as soon as completed.

ST. AUGUSTINE, FLA.—The Southern Bell Telephone Company is planning to make extensive improvements to its system here.

CARTERSVILLE, GA.—The citizens voted June 16 to issue $25,000 bonds for a municipal electric light plant.

BRUNSWICK, GA.—Plans are being prepared by the Southern Bell Telephone Company for a new exchange building at Brunswick, Ga.

WAYNESBORO, GA.—Sydney C. Jones, city clerk, writes that the citizens voted June 14 to issue bonds for water works, sewers and electric lights.

GRANGEVILLE, IDA.—Estimates have been approved by the Pacific States Telephone & Telegraph Company for the rebuilding of the Grangeville exchange and putting in an up-to-date telephone system at a cost of about $2,500.

CAMP POINT, ILL.—At an election the citizens voted against municipal ownership of the local electric lighting plant.

CAMP POINT, ILL.—The Camp Point Electric Light & Power Company has sold its plant to a company consisting of A. A. Callahan, E. B. Sawyer, of Camp Point, and E. E. Hollister and George C. Gill, of Quincy, Ill. The new company will erect a new building and install a new engine and boiler. The electrical part of the plant was rebuilt last year.

RICHMOND, IND.—The City Council has appropriated $35,000 for the purchase of new machinery for the electric light plant.

GOSHEN, IND.—Plans have been made by Frank Shaffer for the rebuilding of the entire electric lighting system in this city.

FORT WAYNE, IND.—The Ft. Wayne & Springfield Traction Company has been financed for the construction of its line between Ft. Wayne and Decatur.

KOKOMO, IND.—The proposition to install a new electrical fire alarm system in this city is now being considered and it is expected that bids will be invited soon.

INDIANAPOLIS, IND.—The Indianapolis, Huntington, Columbia City & Northwestern Traction Company has increased its capital stock from $50,000 to $1,500,000.

COLUMBUS, IND.—C. F. Ferguson has filed a petition for a franchise for an interurban railway which he is projecting from this city to West Lick and West Baden.

RICHMOND, IND.—An ordinance has been passed by the City Council requiring all telephone companies to place their wires under ground when they reconstruct their plants.

CONNERSVILLE, IND.—The Connersville Natural Gas Company has been granted a franchise to construct and operate an artificial gas and an electric lighting plant in this city.

GREENCASTLE, IND.—An electric lighting plant is to be installed by the auohtrities of De Pauw University for the purpose of lighting the buildings. The plant will cost from $5,000 to $6,000.

GREENWOOD, IND.—The Central Union Telephone Company has obsorbed the Greenwood Telephone Company. The present wire system will be supplanted by cables as rapidly as possible.

ANDERSON, IND.—The Remey Electric Manufacturing Company, of this city, has let a contract to Bert Wright to erect a large addition to the company's present plant. The new addition will be equipped with electrical machinery.

WALKERTOWN, IND.—The new municipal electric lighting plant is being installed in this town. The equipment will consist of a 50-kw alternator, a 125-hp engine and 21 series arcs. Norman McKenzie will have charge of the plant.

INDIANAPOLIS, IND.—The plans for the remodeling of the City Hospital include an entire new heating and electric lighting equipment and a laundry which will also have electrical apparatus. The improvements will cost $100,000.

PERU, IND.—The McCarmack Construction Company, of Columbus, Ind., has secured the contract to erect the new Court House in this city for $227,000. The plans contain several new features relative to electrical equipment, and when completed the building will be the best lighted and equipped in the State.

ARDMORE, I. T.—The Ardmore Electric Company has been granted a franchise for an electric railway system in this city.

CHICKASHA, I. T.—It is reported that the financing of the City Railway Company has been successfully carried out, and that construction work will commence within 30 days. Eight miles of track will be laid.

BEDFORD, IA.—J. J. Clark has petitioned for a franchise for an electric light plant.

DOON, IA.—The citizens have voted to issue bonds for the construction of a lighting plant.

FAIRFIELD, IA.—The plant of the Fairfield Gas & Electric Company was destroyed by fire on June 18.

WATERLOO, IA.—G. H. Merrill has secured the contract to erect an electric light station for the Citizens' Gas & Electric Compay.

IOWA CITY, IA.—Work has commenced on the new power house for the State University. Prof. B. J. Lambert will have charge of the construction work.

OSKALOOSA, IA.—The Home Telephone Company will make extensive improvements in its system in this city. A new building is to be erected at a cost of $50,000 and all of the wires are to be placed underground.

DES MOINES, IA.—The North Des Moines plant of the Iowa Heat, Light & Power Company, which was advertised to be sold at a sheriff sale on June 18, failed to attract a single bidder. The plant was ordered sold on an execution given the Iowa Loan & Trust Company for $12,000.

CHERRYVALE, KAN.—Chas. F. Fertig and E. H. Sunderlin, of Colorado Springs, Col., have purchased the plant of the Cherryvale Electric Light & Power Company, and will expend about $50,000 in improvements.

DANVILLE, KY.—It is reported that contracts will soon be awarded for the construction of the Danville & Scottville Railway. Work will begin at McKinney and will proceed in both directions.

BALTIMORE, MD.—The United Railways & Electric Company has completed the surveys for a line from Towson to Timonium. It is expected to have the line completed in September. It is understood that it is the intention of the company to ultimately build the line through to Cockeysville.

BALTIMORE, MD.—The merger of the Consolidated Gas, Electric Light & Power Company and the Consolidated Gas Company was effected June 20. The new company will be known as the Consolidated Gas, Electric Light & Power Company. The officers of the new company are as follows: Gen. Ferdinand C. Latrobe, president; Alten S. Miller, vice-president and general manager; Joseph W. Clark, treasurer; W. Stuart Symington, assistant treasurer; Charles M. Cohn, secretary; Douglass Burnett, manager of electrical department.

WORCESTER, MASS.—The Worcester Electric Light Company will soon commence work on the construction of its underground system in this city.

LEOMINSTER, MASS.—The Leominster Electric Light & Power Company has advised the Selectmen that it will continue the custom of furnishing, without charge, light for the band stands at the evening concerts.

FALL RIVER, MASS.—An electric lighting plant is being installed in the boiler house near the wharf station. Electricity will be furnished to the wharf station, the cotton sheds and other buildings in this vicinity.

PITTSFIELD, MASS.—The New York, New Haven & Hartford Railroad Company has decided to light all of the stations on the Berkshire division between this city and Great Barrington by electricity, which will be furnished by the Berkshire Street Railway Company.

HOLYOKE, MASS.—The new power plant of the Holyoke Water Power Company is completed and in readiness to supply electricity. The B. F. Perkins Company will use electric power as soon as arrangements are completed for operating its machinery by electricity.

MIDDLEBORO, MASS.—A. H. Eaton, town clerk, has been appointed a member of the committee to have charge of the purchase of the new machinery for the electric light station, taking the place of C. H. Leonard, who resigned. The committee has organized with Elisha T. Jenks as chairman and A. H. Eaton as secretary. Mr. Eaton states that bids will probably be received in July for the machinery for the municipal lighting plant.

WEST SPRINGFIELD, MASS.—At a special town meeting held recently the selectmen were authorized to make a contract for street lighting. The United Electric Light Company, which now has the contract for lighting the streets, offered to renew the contract for a term of three years with a concession of 10 per cent of the company's commercial receipts in consideration of the use of the poles and wires that are town property. The company has agreed to furnish electricity for 1200 arc lamps at $73 per year, and 40-cp incandescent lamps at $12 per year, provided enough lamps are used to give the company an annual revenue of at least $6,500. The selectmen are now empowered to make the contract, and will consider the bids of any other person or company that may desire to bid for it.

GRAND RAPIDS, MICH.—The sub-station of the Grand Rapids-Muskegon Water Power Electric Company at Wealthy Avenue bridge is nearly completed, and it is expected that the company will be ready to furnish electricity to the local consumers who have already contracted for it within 30 days. No effort will be made to contract for further power until the new dams have been built, which will not be completed for another year. The Muskegon Interurban Company is using energy furnished by the company. In Muskegon two large factories, the Shaw Electric Crane Company and the Amazon Hosiery Company, are both using electricity supplied by the Grand Rapids-Muskegon Water Power Electric Company. The large plant which is being erected by the Brunswick-Balke-Collender Company will also be supplied with energy by the electric company.

STAPLES, MINN.—The Northwestern Telephone Company will rebuild the local exchange in this place.

MOOSE LAKE, MINN.—The Barnum Telephone Company has been granted a franchise for a local exchange.

MINNEAPOLIS, MINN.—The contract for the construction of the addition to the power house at the State University has been awarded to J. and W. A. Elliott.

DULUTH, MINN.—Bids are wanted until July 9 for $375,000 bonds for the purpose of improving water and light plant. H. W. Cheadle is city clerk.

BERMIDJI, MINN.—The Northwestern Telephone Exchange is contemplating a number of improvements to its system in this city. The service is to be enlarged and a heavier line built.

NASHWAUK, MINN.—Bids will be received by the Village Clerk until July 10 for the installation of a 50-kw dynamo, wiring, pole line and engine. Claussen, Burch & Pillsbury, of St. Paul, are the engineers.

DULUTH, MINN.—At a recent meeting of the City Council a resolution was passed authorizing the water board to make a contract with the Great Northern Power Company to furnish electricity for operating the pumping station. Under the proposed contract the maximum price for pumping 1,000,000 gallons is $6.50. Last year it cost the city $8.90 per million gallons without counting the cost of depreciation in the plant.

JACKSON, MISS.—The Jackson Electric Light, Railway & Power Company has changed its name to the Edwards House & City Railway Company, and is now operating under a charter bearing that title.

LA BELLE, MO.—The municipal electric light plant was destroyed by fire on June 17. It will be rebuilt.

SEDALIA, MO.—The Business Men's Association of this city has applied to the City Council for a franchise to sell gas and electricity and to operate a street railroad.

CARTHAGE, MO.—The City Councils of Carthage and Joplin have granted a franchise to the company which proposes to build an electric railway from Independence to Chanute.

ST. JOSEPH, MO.—The Citizens' Telephone Company is now making arrangements for making many improvements and greatly enlarging its system in this city. Dr. J. J. Newell is manager.

ST. LOUIS, MO.—The Board of Public Improvements has authorized the Western Union Telegraph Company and Postal Telegraph Companies to place their wires under ground in the downtown section of the city.

ST. LOUIS, MO.—The capital stock of the Suburban Telephone Company has been increased from $100,000 to $600,000. A certificate to this effect has been filed at Clayton, St. Louis County. H. W. Karrenbrock is president and Joseph B. Greensfelder, secretary.

BENEDICT, NEB.—The Village Board has purchased the electric lighting plant of W. G. Keeler for $2,200.

RULO, NEB.—The Village Council is endeavoring to have an electric light and water works plant established in this village.

UNIVERSITY PLACE, NEB.—The question of issuing bonds for improving the electric light plant is now being considered.

WYMORE, NEB.—The Bell Telephone Company is preparing to rebuild its system. The improvements contemplated will cost about $25,000.

SWEETWATER, NEV.—The New Bodie Mining Company is making arrangements for the construction of a large electric generating station on the East Walker River, which is intended to supply electricity for operating the mines of Aurora, Masonic, Bodie and southern Nevada. It is said that 10,000 hp will be developed, and that the station alone will cost $150,000. W. D. Searles is chief engineer of the New Bodie Mining Company.

FRANKLIN, N. H.—The Franklin Light & Power Company is preparing to construct a new electric power plant at Giles Mills. Material has been received for the construction of the new penstock.

SOUTH ORANGE, N. J.—Charles H. Ingersoll, who advocated the establishment of a municipal lighting plant in South Orange, a project which met with opposition, now offers to subscribe $5,000 to a fund to be used for the purpose of erecting a plant which will supply electricity to the village at a lower rate than is now paid.

POTSDAM, N. Y.—The citizens voted June 14 to issue $24,000 bonds for an electric light plant.

FREDONIA, N. Y.—The Village Trustees are considering improvements to the electric light plant, to cost about $10,000.

BROCKPORT, N. Y.—The Village Board has granted a franchise to the Buffalo, Lockport & Rochester Electric Railway Company to extend its lines to the streets of this village.

FORT SLOCUM, N. Y.—Sealed bids will be received by E. N. Jones, constructing quartermaster until 11.15 A. M., July 10, 1906, for the construction of an electric lighting system.

SENECA FALLS, N. Y.—The Seneca Edison Company has made application to the State Gas and Board Commission for permission to consolidate with the Geneva Light & Power Company.

BROOKLYN, N. Y.—The H. B. Smith & Company has engaged Frank M. Smith, architect, of Cincinnati, Ohio, to draw the plans and supervise the construction of its power plant to be erected on Kent Street. The plant will cost $1,000,000.

SYRACUSE, N. Y.—Joseph Dunfee, of Syracuse, has secured the contracts for the construction of the conduit systems for the telephone wires in Oswego, Fulton and Baldwinsville. The Oswego contract calls for an expenditure of $25,000—Fulton, $10,000, and Baldwinsville, $10,000.

HART'S ISLAND, N. Y.—Bids will be received until July 3 by Francis J. Lantry, commissioner of correction, New York City, for furnishing and installing a new 100-kw compound and shunt-wound 250-125-volt, three-wire engine type generator, with field rheostat for switchboard mounting, etc., on Hart's Island.

MIDDLETOWN, N. Y.—The West Branch Light & Power Company has been granted a certificate of authority by the Commission of Gas and Electricity to supply electric light in the villages of South Kortright, Hobart and Stamford, Delaware County. Bonds to the amount of $45,000 may be issued by the company, and capital stock to the amount of $5,000. The company also received consent to purchase the stock of the Stamford Electric Light Company.

CHARLOTTE, N. C.—The Charlotte Consolidated Construction Company has under consideration the building of an electric railway to the Catawba River, 12 miles distant, furnishing a resort for the people of Charlotte.

CHARLOTTE, N. C.—The Southern Power Company proposes to build a transmission line to Statesville, a distance of about 50 miles, and expects later to furnish electricity to Statesville from another water development, farther up the Catawba River.

WINSTON-SALEM, N. C.—William and Sinclair Mainland, of Oshkosh, Wis., have purchased the gas and electric plants in this city and contemplate extensive improvements. It is said that about $200,000 was paid for the properties, and that they will be turned over to the Continental Public Utilities Corporation.

GRAND FORKS, N. D.—Edward L. Healy, of Red Lake Falls, Minn., has secured a franchise for an electric light plant.

CLEVELAND, OHIO.—The stockholders of the United States Telephone Company have voted to increase the capital stock from $2,500,000 to $5,000,000.

BELLEFONTAINE, OHIO.—The Urbana, Bellefontaine & Northern Traction Company will build a new city line on West Columbus Avenue to the corporation line.

DAYTON, OHIO.—The Board of Public Safety has petitioned for an appropriation of $15,000 for the purpose of putting the wires of the police and fire department underground.

NILES, OHIO.—The contract for furnishing a steam engine, generator and street lighting system for the municipal electric lighting plant has been awarded to the Machinery Sales Company.

STEUBENVILLE, OHIO.—The Council of Wellsburg has granted a franchise for the Wellsburg terminus of the Wheeling & Bethany Electric Railway. The company will commence construction work immediately.

LAKEWOOD, OHIO.—Chas. W. Root, Village Engineer, 736 Society for Savings Building, Cleveland, writes that an election will be held on July 5 to vote on issuing $25,000 bonds for the extension of the electric light plant.

SPRINGFIELD, OHIO.—John S. Harshman, general manager of the Springfield & Washington Traction Company, states that work on the extension of the line of South Charleston to Washington C. H. will be started within the next few weeks. Arrangements have been made for selling the bonds on the extension, and material is now being purchased.

COLUMBUS, OHIO.—Dr. S. B. Hartman, of Columbus, has made application to the County Commissioners for a franchise to build a suburban line from the south end of the Central Market Street line, along High Street to the Hartman farm, opening up a new suburban district. It is stated that when this line is completed the road will be extended to Commercial Point and Washington C. H.

ZANESVILLE, OHIO.—The Southeastern Ohio Railway & Light Company has commenced the construction of a dam across South River at Powell's Mills. A lake will be formed supplying water to the new power station. The villages of Roseville and Crooksville have submitted a proposition to the company to install additional pumps at its power station and to build pipe lines to supply these villages with water.

CLEVELAND, OHIO.—The Cleveland Construction Company, which has the contracts for building the Youngstown & Ohio River Railway from Columbiana to Lisbon and East Liverpool, and the Cleveland, Ashland & Mansfield Traction Company's line from Seville to Ashland and Mansfield, has placed contracts for trolley wire, direct-current and high-tension feeders, with the American Steel & Wire Company, covering the quantities needed for both lines. Several other contracts for miscellaneous material have also been closed. Proposals are under consideration for power-house equipment. Both steam turbines and reciprocating engines are being considered; two units of 1,000-hp capacity each will be purchased, and the contracts will be closed in the near future. Work of grading has already been started on both of these roads.

FREELAND, PA.—The Borough Council has granted a franchise to the Consumers' Electric Light Company.

DELTA, PA.—The Castle Fin Electric Company is preparing to build an electric plant at Castle Fin Forge on Muddy Creek.

NEW HAVEN, PA.—D. S. Martin, of Bellevue, has secured the contract for constructing an electric light plant for $15,000.

POTTSVILLE, PA.—The Borough Council will receive bids until September 18 for lighting the borough for 5 years from February 15, 1907.

DANVILLE, PA.—The contract for the construction of the power house for the Hospital for the Insane has been awarded to J. T. Buchanan & Company.

JOHNSTOWN, PA.—The Dale Borough Light, Heat & Power Company will make application to the City Council for a franchise to furnish heat, light and power in this city.

WILKESBARRE, PA.—A company has been organized with J. B. Ford, president and Geo. McDonald, secretary, to establish a new lighting plant in Wilkesbarre.

READING, PA.—The Edison Illuminating Company and the West Chester Steam, Heat & Power Company have consolidated under one charter, with a capital stock of $70,000.

READING, PA.—The contract for furnishing electricity for lighting the County Home has been awarded to W. F. Krick, of Sinking Spring, at the rate of 30 cents per lamp per month. About 225 lamps will be used.

LOCK HAVEN, PA.—The Council has entered into a contract with the Lock Haven Electric Light & Power Company to furnish street lamps for a term of five years. The company is to furnish 80 or more lamps of 2,000-cp each at $65 per lamp per year. The price paid under the old contract was $71 per year.

BIRDSBORO, PA.—Work on the new power plant of the Birdsboro Electric Company, which is now being erected near the canal locks, is progressing favorably. The new water wheel has been installed and is working satisfactory. The steam engine, dynamo and other equipment will soon be moved from the present plant and placed in the new building.

ALTOONA, PA.—The Altoona, Hollidaysburg & Bedford Springs Railway Company has awarded the contract for the construction of its power house to the Allis-Chalmers Company, of Milwaukee, Wis. The contract calls for two 500-kw railway generators, two 800-hp Corliss engines. Four 300-hp Babcock & Wilcox water-tube boilers will be installed. The plant will be located at Duncasville.

PROVIDENCE, R. I.—Bids will be received until July 2 by Jeremiah H. Hall, chairman committee on city property, for installing ventilating and heating system, engines, generators, belting and switchboard required for the additions and alterations to the Technical High School. The Richard D. Kimball Company, Beacon Street, Boston, Mass., is the engineer. Martin & Hall, Providence, are the architects.

CHARLESTON, S. C.—Bids will be received until July 21 by Mordecai T. Endicott, Chief Bureau Yards and Docks, Navy Department, Washington, D. C., for furnishing at the Navy Yard, Charleston, S. C., two air compressors and accessories as per specification 1497; estimated cost, $22,000; boilers and accessories, coal handling apparatus, electrical equipment, pumps and piping as per specification 1498; estimated cost, $90,000; four turbo-alternators, engines, generators, switchboard, wiring, etc., as per specification 1499; estimated cost, $85,000.

LLANO, TEX.—The Texas Telegraph & Telephone Company is preparing to extend and improve its lines. Several of the lines will be entirely rebuilt. The company contemplates an expenditure of about $10,000.

LAREDO, TEX.—Bids will be received until July 17 by James Knox Taylor, supervising architect, Treasury Department, Washington, D. C., for installing a conduit and wiring system in the U. S. Post Office, Court House and Custom House at Laredo.

SALT LAKE CITY, UTAH.—The Utah Copper Company, of which D. C. Jacklin is general manager, has awarded the contract for the electrical equipment for the new Garfield mill to the General Electric Company.

OGDEN, UTAH.—The Ogden Electric Supply & Fixture Company has been awarded a contract by the Utah Smelting Company to put in a transmission line, together with all machinery, from Brigham City to the smelter.

RICHMOND, VA.—The Southern Bell Telephone Company will spend about $400,000 for extensions and improvements to its system in this city this year. A new building is to be erected and new switchboard installed and the wires are to be put underground.

RICHMOND, VA.—The Committee on Electricity has asked the city attorney, superintendent of the water works and city electrician, to frame an ordinance providing for an electric light plant for municipal uses only, not to exceed $250,000 in cost, and to report the same at the next meeting of the committee.

NORFOLK, VA.—The Norfolk Railway & Light Company has placed orders for the equipment of its new power house, which will have a capacity of 10,500 kw, consisting of three 3,000 and one 1,500 kw Curtiss turbines, of the condenser type, and fourteen Babcock & Wilcox boilers of 650 hp each, which will be equipped with Roney stokers. The company will install three sub-stations at the present time; one at Ocean View, one at the power house in Norfolk and one at Portsmouth, which will replace several small generator plants. Later on a sub-station will be installed at Suffolk.

YAKIMA, WASH.—The Yakima Inter-Valley Traction Company has been organized here for the purpose of building an electric system for this city and the entire valley.

PORT TOWNSEND, WASH.—Ivan L. Hyman, of Seattle, has purchased the property of the Port Townsend Gas & Electric Company, which was sold at sheriff's sale on May 26.

SPOKANE, WASH.—The Referendum League, recently organized, is stated to have decided to petition the Council to call an election to vote on constructing a municipal electric light plant.

BELLINGHAM, WASH.—The Home Telephone Company is putting in a new automatic telephone system in this city. The company also contemplates putting in a system in Anacortes.

OLYMPIA, WASH.—Plans and specifications have been received for the new telephone exchange building for the Olympia Sunset Telephone Company and work on the structure will begin at once.

PULLMAN, WASH.—Work has commenced on the transmission line from Moscow to Pullman. M. J. Shields & Company, of Moscow, who have a franchise to operate an electric lighting and power plant, which is to be in operation by July 1, have commenced work on the transmission line from Moscow. Power is to be brought from Asotin, Wash. The company will lease the city system until the next general election, when the citizens will vote on the proposition to sell the plant to the company.

BENWOOD, W. VA.—The City Council is considering the question of constructing a municipal lighting plant at a probable cost of $30,000.

MADISON, WIS.—The Council has made an appropriation to buy a site for a municipal electric lighting plant.

ABBOTSFORD, WIS.—This city would like to correspond with parties interested in an electric light franchise. Address Louis Olson, village clerk.

WEST MILWAUKEE, WIS.—The Village Council has awarded to the Milwaukee Electric Railway & Light Company the contract for street lighting at $84 per arc lamp per year.

MANITOWOC, WIS.—The Fox Valley Railway Company has increased its capital stock from $25,000 to $200,000. The company will construct an interurban line between Sheboygan and Kaukauna.

SUPERIOR, WIS.—The Northern Power Company, of Duluth, Minn., has leased a portion of the Superior Water, Light & Power Company's building on Hughitt Avenue for a period of ten years, the space to be used for its generators. The Northern Power Company is to pay $400 a year for the present space and $200 a year for each additional generator installed.

CARDSTON, ALB.—Debentures are being sold for the purpose of installing a municipal electric lighting plant. J. A. Hammer is mayor.

REVELSTOKE, B. C.—The Prince Mining Company is arranging to lay an electric tramway to cost $60,000 from here to the mine. J. A. Stone is vice-president.

ROSSLAND, B. C.—The Trail electric light plant, owned by the Consolidated Mining & Development Company was burned to the ground. Loss, $18,000.

SASKATOON, CAN.—Willis Chapman, civil engineer, of Toronto, has plans for a municipal electric lighting plant which will be installed here. J. Clinskil is mayor.

PRINCE ALBERT, CAN.—Prince Albert rate payers have decided to move the electric light plant to the power house at the water works and to improve the plant at a cost of $35,000.

OTTAWA, ONT.—The civic lighting plant, it is stated, shows a net profit of $826 for 6 months after paying the interest and sinking fund claims.

FORT WILLIAM, ONT.—The International Telephone Company has closed a contract with the town for a new central telephone outfit for 750 instruments. J. Whalen is mayor.

CHATHAM, ONT.—The Chatham, Lake Erie & Wallaceburg Electric Railroad will extend its line from here to Rondeau Harbor, 20 miles, and is having surveys made for a line to Sarnia, a distance of 100 miles.

TORONTO, ONT.—The Toronto & York Radial Electric Railway Company is building a new power house at Keswick. It will be 100 ft. x 150 ft. , and will supply the power for the Metropolitan Electric Railway, from Newmarket to Jackson's Point.

WINNIPEG, MAN.—The City Council has passed a by-law to issue debentures to the amount of $3,250,000 for the purpose of acquiring rights of ways and other necessary property for building and maintaining an electric street railway to be owned by the city, independent of the Winnipeg Electric Street Railway, and for constructing a power plant on the Winnipeg River at a point to be selected by the Council.

WINNIPEG, MAN.—The Board of Works of the Winnipeg City Council has ordered the Winnipeg Street Railway Company to build a new line from the corner of Broadway and Osborne Streets to Portage Avenue. This is to be a double-track line. The company is also ordered to build its new line on Sargeant Avenue, from Sherbrooke to Arlington Streets. The Council has the power to order these extensions by the terms of the company's franchise.

MEXICO, MEX.—The Compania Electrica e' Irradora del Estado de Hidalgo has increased its capital stock from $2,000,000 to $4,000,000.

DAWSON, Y. T.—It is reported that a large electrical plant will be installed this summer to operate the placer mines in Klondyke Basin.

New Industrial Companies.

THE HENRY RYCRAFT & COMPANY, electrical constructors and engineers, with headquarters at 166 Genesee Street, Utica, N. Y., has been formed by Henry Ryecraft.

THE NEW YORK ELECTRIC FOUNTAIN COMPANY, of New York, N. Y., has been incorporated with a capital stock of $20,000. The directors are S. S. Mittenhall, I. M. Mittenhall and G. S. Jacobson, of New York, N. Y.

THE INTERMOUNTAIN CONSTRUCTION COMPANY, of Butte, Mont., has been incorporated with a capital stock of $100,000 for the purpose of building telegraph and telephone lines. The incorporators are T. B. Lane and others.

THE SMITH ELECTRIC & MANUFACTURING COMPANY, of Charlottee, N. C., has been incorporated with a capital stock of $25,000 to carry on a fixture and electrical business in Charlotte. The incorporators are H. C. Dotger, E. F. Cresswell and Samuel J. Smith.

Company Elections.

HARTFORD, CONN.—At the annual meeting of the Farmington River Power Company held recently, the following board of directors was chosen for the ensuing year: Henry Roberts, E. B. Bennett, H. C. Judd, A. C. Dunham, Atwood Collins, John S. Hunter, E. C. Terry, W. W. Smith, James Terry.

NEW ALBANY, KY.—At the annual meeting of the Eureka Telephone Company held recently the present officers were reelected as follows: E. F. Windell, president; H. C. Beanblossom, secretary; H. C. Keys, treasurer.

BALTIMORE, MD.—At the annual meeting of the stockholders of the Mount Washington Electric Light & Power Company held recently at the company's offices, Mount Washington, the following officials were elected for the ensuing year: President and general manager, Thomas W. Offutt; vice-president, Alten S. Miller; secretary and treasurer, Harry J. McIntyre.

LITCHFIELD, MINN.—At the annual meeting of the Litchfield Telephone Exchange Company, held June 11, the present officers were reelected for another year as follows: H. I. Peterson, president; G. H. Sullivan, vice-president; T. F. McClure, secretary; G. A. Settergren, treasurer.

ANACONDA, MONT.—At a recent meeting of the directors of the Montana Telephone Company, Harry A. Gallway, of Butte, was elected president, and Charles J. Kelly, vice-president.

CLEVELAND, OHIO.—At the annual meeting of the Cleveland Telephone Company, held June 15, the following officers were elected: L. R. Richardson, president; Heman J. Pettengill, vice-president; Charles A. Grant, secretary; A. H. Kirkwood, treasurer and assistant secretary; John Balch, assistant treasurer.

New Incorporations.

OAKLAND, CAL.—Articles of incorporation have been filed with the County Clerk for three allied companies, which are to engage in the lighting and power business in Lodi, Auburn and Richmond and the surrounding regions. The incorporators are the same in each company and are as follows: W. F. Russell, C. A. Wilson and M. Brand, of San Francisco; H. A. Potter and F. A. Osborn, of Oakland. The first company is called the Lodi Gas Improvement Company, the second the Auburn Gas Improvement Company, and the third the Richmond Gas Improvement Company. The capital stock of each of the companies is $100,000. The principal place of business is to be at Oakland.

CHICAGO, ILL.—The Carthage & Western Illinois Electric Company has filed articles of incorporation with a capital stock of $2,500. The incorporators are W. M. Vose and others.

LEROY, ILL.—The Leroy & Southwestern Railroad Company has been incorporatd with the principal office at Bloomington. The capital stock is $2,000. The incorporators and first board of directors are Alvin H. Shelby, J. A. Taylor, Bloomington, Ill.; L. A. Hinton, A. Hinton, Normal, Ill.; George W. Shelby, Wapella, Ill.

SPURGEON, IND.—The Spurgeon Home Telephone Company has filed articles of incorporation. The capital stock is $12,000. The directors are E. H. Grubb, J. A. Wiggs and John W. Scales.

WINCHESTER, IND.—Articles of incorporation have been filed by the Muncie & Union City Traction Company with a capital stock of $500,000. The directors are James A. Van Osdol and others.

MUNCIE, IND.—The Ardmore Heat & Light Company has been incorporated with a capital stock of $200,000, to produce oil and gas, build pipe lines, construct and operate gas and electric light plants and to sell gas, oil and electricity for heat, light and power. John W. Smith is chairman board of directors.

MOORLAND, IA.—The Moorland Mutual Telephone Company has filed articles of incorporation.

COLO, IA.—Articles of incorporation have been filed by the New Albany Mutual Telephone Company with a capital stock of $5,000.

AUGUSTA, ME.—The Tri-State Telephone & Telegraph Company has filed articles of incorporation with a capital stock of $3,000,000. E. H. Moulton is president.

MINNEOTA, MINN.—The Minneota Telephone Company has been incorporated with a capital stock of $5,000.

LINCOLN, NEB.—The Fillmore County Telephone Company has increased its capital stock to $100,000.

MARTEL, NEB.—Articles of incorporation have been filed with the Secretary of State by the Martel Farmers' Telephone Company with a capital stock of $500. The officers are Albert Egger, president; John A. Sittler, vice-president; William H. H. Moore, secretary; Edward H. Bohmont, treasurer.

BUFFALO, N. Y.—The Buffalo & Lackawanna Traction Company has filed articles of incorporation with the Secretary of State. The company operates a five-mile electric road in Buffalo, and has a capital stock of $1,000,000. The directors are J. B. Mayer, W. F. Sheehan, C. H. Werner, M. J. Dodge, Ashley T. Cole, of New York; J. C. Calisch, J. F. Burke, C. V. Nellany and O. F. George, of Buffalo.

BONSAL, N. C.—The Cape Fear Telephone Company has been chartered with a nominal capital stock of $675. T. L. Womble is incorporator.

HILLSBORO, OHIO.—The Hillsboro, Belfast & Peebles Traction Company has been organized for the purpose of building a line through Belfast and Peebles with a branch to the Ohio River at Aberdeen. The officers are P. M. Hughes, Lovett, president; J. W. Letherman, Belfast, vice-president; W. B. Cochrane, Hillsboro, secretary.

CLEVELAND, OHIO.—The Municipal Traction Company has been incorporated with a capital stock of $10,000 for the purpose of leasing the Forest City Street Railway Company. The last-named company has increased its capital stock from $250,000 to $2,000,000. Of this amount $700,000 will be issued at once and will be used in the completion of the

lines already started, the purchase of power house equipment, rolling stock, etc. The remaining $1,300,000 will be issued and sold from time to time and the proceeds applied to new construction. The property which the Forest City Railway Company will turn over to the Municipal Traction Company consists of five miles already built and nine miles under construction.

HOUTZDALE, PA.—A company has been organized here under the name of the Houtzdale Electric Light, Heat & Power Company, with a capital stock of $10,000. Samuel T. Henderson is treasurer.

EDENSBURG, PA.—At a meeting of the telephone companies in the northern part of Cambria County it was decided to consolidate all the independent farmers' line under one company to be known as the Northern Cambria Farmers' Telephone Company. H. M. Gooderman was elected president.

Legal.

SOUTH TEXAS TELEPHONE ENJOINED.—Mr. H. E. Huntington, the Los Angeles, Cal., street railway man, who is making an effort to obtain control of the long distance independent telephone properties in the Southwest, to-day obtained a temporary injunction in the district court, Austin, Tex., against the South Texas Telephone Co., restraining its representatives from hypothecating $115,000 of its bonds.

TELEPHONE UNDERGROUND WIRES.—In an action brought by the village of Carthage against the Central New York Telephone & Telegraph Company, the Court of Appeals has just rendered a decision against the village. The suit was brought to determine whether the village had the right to compel the company to put its wires under ground. Justice Andrews at special term decided in favor of the company, and from the decision the village appealed to the Appellate Division, which reversed Justice Andrew's decision. The companpy then took the case to the Court of Appeals, which decides in the negative the question whether a village can compel a telephone company to put its wires under ground.

GAS PRICE REDUCTION VALID.—The Appellate Division of the Supreme Court of New York has handed down a decision against the Consolidated Gas Company in two cases. The court holds in effect that the company must not shut off the gas from any consumer who tenders the 80-cent rate fixed by the last session of the Legislature. Justice Laughlin wrote the opinion, Presiding Justice O'Brien and Justice Patterson concurred. Dissenting opinions were written by Justice McLaughlin and Houghton. In his dissenting opinion Justice McLaughlin says: "It is a somewhat alarming proposition that a legislative body can simply by its own fiat arbitrarily fix the price at which the owner of a product must sell it, and it is equally so that a court will refuse to the owner of the product the right to sell it at the price at which he had heretofore sold it, pending a judicial determination as to the validity of the legislative act, when sufficient money is paid into court to reimburse a purchaser for the difference in price in case the act is declared valid." Justice Houghton, also dissenting, says he does not think that the State courts have been ousted by the Federal courts from jurisdiction, buf he thinks that no extraordinary remedy in the form of a temporary injunction should be granted.

SERIES PARALLEL CONTROLLERS.—In the United States Circuit Court of Appeals for the third circuit, sitting in Philadelphia, Pa., a patent decision was handed down on June 11th in favor of the General Electric Co., who had brought suit against the Garrett Coal Co. on the charge that the defendant company had been using series parallel controllers, manufactured by the Morgan-Gardner Electric Co., of Chicago. These controllers, it was alleged, are an infringement upon the plaintiff's patents No. 587,441 and 587,442 of August 3rd, 1897. The Court of Appeals speaks in high terms of the invention contained in these two patents and states the advantages as follows: "The method is a gradual, or step by step, progress from the series to the parallel supply of the electric current to the motors, by which the current may be safely broken as to one motor in series, the same be at once changed to parallel relation to the other, and the multiple rate of speed attained, without shock and without sparking, there being, during the progress, no shutting off of the current or reduction of speed." This decision covers the "K" form of controller of which more than 86,000 have been sold and put into operation, and which is used almost exclusively on electric street railway systems of this and other countries.

NIAGARA POWER NOT INJURIOUS.—In a report filed by Referee Charles M. Williams in the condemnation proceedings brought by the Niagara, Lockport and Ontario Power Company to acquire the lands of Mary Van Riper in the town of Brighton, the referee holds that the company has the right to condemn land in Monroe or any other county along the line from Lockport to Syracuse. A decision filed by Justice Sutherland in the case of Mary S. Oliver gave the company temporary possession of the property on the same grounds, though a settlement of the case was effected before it had been concluded on its merits, an appeal having been taken from a preliminary ruling. The referee was appointed October 25, 1905, by Justice Sutherland to take testimony in the case. As in the opinion given by Justice Sutherland, the opinion holds that the corporation is a public service corporation within the meaning of Chapter 722 of the laws of 1894, and thus has the right of extension beyond the limits of Niagara, Orleans and Erie County, the counties named in the charter. The conclusions of the law also find that the company has full authority to take from the Niagara River the amount of water necessary to develop a practically unrestricted amount of power at Lockport. The grant of the charter to the company by the Legislature, it is stated, was a valid grant and gives the company full authority to divert water from the river within the provisions of this grant. The opinion also holds that the grant of these privileges does not grant to the company any money or property of the State of New York within the meaning of Section 9 of Article I of the constitution. The findings of the fact go into a long discussion of the company's history from its incorporation, including the purposes for which it was formed. A power canal, work on which was commenced a year or two ago, but which is still uncompleted, awaiting the outcome of the charter rights which are still questioned, is discussed in detail. This canal, it is stated, will be used to develop power at Lockport, at which place not over 10,000 horse-power annually will be consumed. At this point, it is stated, the transforming station is located and the company must necessarily transmit power to other places. This is one of the basic grounds for the ruling as to the necessity for extension. It is also found that the scenic effect of Niagara Falls will not be affected by the water which is taken from the river. The referee finds that the claim that the navigability of the Niagara River from Lewiston to Lake Ontario would be affected is unfounded and says that the navigability of this stretch of the river would not be affected if all the water from the river were to be diverted at Lewiston by another channel into Lake Ontario, as the water would get back into the lake. Above Lewiston, the report states, the river is only navigated as far as the falls by the Maid of the Mist. The development of from 100,000 to 200,000 horse-power at Lockport would reduce the water in the upper level from 3 to 6 inches only.

Obituary.

MR. H. BOTTOMLEY.—Mr. John Bottomley, vice-president of the Marconi Wireless Telegraph Company, received word this week of the death of his brother, Harry Bottomley, at Knutsford, England, on June 23. Harry Bottomley was born in Belfast, Ireland, 32 years ago. He was the son of William Bottomley, a justice of the peace. For the last three years he had been assistant treasurer of the English branch of the Westinghouse company. Before taking that place he was a tea planter in India. He leaves a widow.

MR. C. E. TRIPLER.—Mr. Charles Eastman Tripler, inventor of a method for making liquid air, died on June 20, of Bright's disease, at Liberty, N. Y., after an illness of several months. He was born in New York City in 1849, and while attending private schools showed an aptitude for mechanics and chemistry. When he was 23 years old he constructed a naphtha condensing engine and then devoted himself for several years to experimenting with chemicals. In 1890 he discovered a method of liquefying air, and two years later succeeded in producing liquid oxygen and nitrogen. His method employed great compression and produced a temperature of 312 degrees below zero. A stock company capitalized at $20,000,000 was formed to put the discovery into commercial use, and all sorts of claims were made for the product. The company was never a financial success. Mr. Tripler made a demonstration with liquid air at the Electrical Exhibition in New York City a few years ago.

MR. C. C. NEWTON.—The death of Charles C. Newton, president and treasurer of the Newton Machine Tool Works, Inc., Philadelphia, occurred at Bremen, Germany, June 13. He had not been in good health for some time and had gone to Europe to seek relief. He was born February 9, 1846, at Cambridge, Washington County, N. Y., and at the age of 19 he indentured himself as apprentice to the Brooks Locomotive Works at Dunkirk, N. Y., spending most of his time in the tool room. After serving his apprenticeship and working in various shops, Mr. Newton returned to Dunkirk in 1875, and, in partnership with J. D. Cox, manufactured twist drills, reamers, cutters, etc., removing to Cleveland, O., in 1876, to broaden the scope of their work, which had largely increased, operating under the firm name of Newton & Cox. In 1880 Mr. Newton sold out his interest to Mr. Cox, who formed out of the old firm the Cleveland Twist Drill Company. Removing to Philadelphia Mr. Newton laid the foundation for the present Newton Machine Tool Works. He was the sole proprietor of the works until July 14, 1897, when articles of incorporation were taken out, and the firm became the Newton Machine Tool Works, Inc., with Mr. Newton as president and treasurer. He was a member of the Engineers' Club and of the American Society of Mechanical Engineers.

Personal.

MR. W. R. COOPER, M. A., B.Sc., M. I. E. E., A. M. Inst. C. E., has been offered and has accepted the editorship of the London *Electrician*, in the place of Mr. F. C. Raphael, who retires June 30.

MR. N. A. CHRISTENSEN, who has just associated himself with the Allis-Chalmers Company, for air compressor, brake work, etc., is making a trip to Europe before assuming his new duties, and will spend the time over there chiefly in automobiling.

MR. WM. B. FLYNN, assistant electrical engineer of the New York, Westchester & Boston Ry. Co., was married June 16 to Miss Edna Anson of Hasbrouck Heights, N. J. The couple afterwards left for a two weeks' trip through Northern New York.

DR. F. S. PEARSON has sailed for Europe, accompanied by Mrs. Pearson. From London they will go to Rio de Janeiro, Brazil, where Dr. Pearson has large interests in the electric lighting, trolley and telephone system, and has a large power transmission enterprise in Land.

MR. N. B. ROPER, formerly chief engineer for the Cananea Consolidated Copper Company, Cananea, Mexico, has recently been engaged by the Power and Mining Machinery Company, Milwaukee, Wis., as mining engineer to represent it at its New York sales office, No. 52 William St.

MR. F. F. FOWLE, formerly of New York City, is now permanently located in Chicago as manager there for the American Telephone & Telegraph Company. Mr. Fowle has made a specialty of long distance telephone work and of late has given great attention to installations for railroads—work that involves many interesting problems.

MR. WALTER C. DEAN has opened offices in the Bank of Commerce Building at Norfolk, Va., and will represent the C. & C. Electric Company there. He is a graduate of the Massachusetts Institute of Technology, and has had considerable experience in the equipment department of the Norfolk Navy Yard, where he has made a specialty of variable speed motors for driving machine tools.

MR. PAUL J. KRUESI, secretary-treasurer of the American Lava Company, of Chattanooga, Tenn., has, according to the journals of that city, become engaged to Miss Myra Kennedy Smartt of Chattanooga. The wedding will take place during the summer, and the honeymoon be spent north. Mr. Kruesi is the son of the late John Kruesi, one of the founders of the Edison lighting industry in America.

MR. J. G. WHITE took a large party of friends in the electrical and financial worlds, by special car, on Saturday, June 23, to see the 'Varsity boat races at Poughkeepsie. Assisted by Messrs. Gossler, Collette, Reed and Bunnell of the J. G. White Company, he extended lavish hospitality and the day was not marred for the host by the sight of his alma mater, Cornell, pulling off two of the big events in splendid style.

MR. W. H. WHITESIDE.—Among the passengers leaving New York for Liverpool, June 19, on the Cunard steamer "Coronia" was President W. H. Whiteside of the Allis-Chalmers Company, who, accompanied by his wife and daughter, will devote several weeks to a recreation trip abroad. Mr. Whiteside and his family will visit various points of interest in England, Germany, Switzerland and France, spending most of their time on the Continent.

MAJOR F. V. HANSEN, of Sweden, with Mr. G. Malm, C. E., has been making an investigation of the chief American and Canadian hydro-electric plants, with the objects of ascertaining how far they may suggest methods for the utilization of the Trollbattan Falls, which the Swedish Government proposes to utilize for electrical work on the State railroads. They have accumulated a large amount of data and sailed for home this week.

MRS. W. C. GOTSHALL, wife of the railroad promoter, broke ground last week for the New York and Port Chester Railroad, using a gold shovel. After six years of legal battle in the courts and before the State Railroad Commissioners and the city authorities, the Port Chester Railroad Company has won. The road will cost $30,000,000. It will consist of twenty-five miles of four-track road, operated by a third rail. Its temporary terminus in Manhattan will be at 177th St. and the subway. It will be ready in about two years.

MR. GEO. U. G. HOLMAN, who promoted and built the Levis County Railway, Quebec, Canada, and now of 180 Broadway, New York City, is associated with Mr. L. Knowles Perot, of Philadelphia. Mr. Holman was recently appointed electrical engineer of the Valley Forge System, which will build and operate a third-rail private right-of-way line between Philadelphia and Phoenixville, Pa., with Philadelphia offices on the twenty-first floor, Land Title Building. He is also vice-president of the Public Service Investments Company, which is the holding company for eleven Pennsylvania corporations. Mr. Holman retains his New York office.

MR. GARDNER C. SIMS, having recently been elected to the presidency of the William A. Harris Steam Engine Company of Providence, R. I., builder of Corliss engines, has resigned his position as general manager of the Marine Engine & Machine Company, of Harrison, N. J., and will return to Providence to assume his duties there. The William A. Harris Steam Engine Company has purchased a large tract of land at Central Falls, R. I., and plans are now being prepared for the building of new works. Mr. Sims has a world-wide reputation as a builder of high-speed, closely regulating engines, and his valuable aid in the beginnings of the electric lighting art in this respect are not likely to be forgotten.

MR. F. E. DRAKE, who has been actively and prominently connected with the development of American interests in Germany, and is now director of the International Pneumatic and Electric Company, of Berlin, has sustained a severe bereavement in the death of his wife in that city. Mrs. Drake had been ill for some time, and had visited the Riviera in the quest for health. The end came suddenly and painlessly. Mrs. Drake was a member of the executive committee of the American Woman's Club of Berlin, which misses her as an influential worker in behalf of its social and charitable interests. The funeral services were held in the American Church at Berlin on May 31, and were attended by U. S. Ambassador Tower and many members of the American colony.

BATES-VERNAM.—One of the largest weddings held in Morristown, N. J., this season was that of Miss Emeline Goold Vernam, daughter of Mr. and Mrs. Albert H. Vernam, to Putnam Asbury Bates, the consulting electrical engineer, of New York. The wedding was celebrated in St. Peter's Church. The ceremony was performed by the rector, the Rev. Philemon F. Sturges. Miss Alice Vernam was her sister's maid of honor, and the bridesmaids were Miss Matilda Frelinghuysen, Miss Emily Maver, Miss Carrie Warfield, Miss Elizabeth Heron of Pittsburg, Miss Adelaide McAlpin of New York, and Miss Marguerite Vernam. The best man was T. Power Bates, brother of the bridegroom, and the ushers were A. Harold Vernam, Jr., a brother of the bride, John Grenville Bates, brother of the bridegroom, Albert H. Putnam, Anton H. Schafer, William W. Pressprich, Walcott P. Robbins, Leonard S. Horner, and William B. Boulton, Jr., all of New York. Immediately after the ceremony a reception was held at the Vernam home on Madison Avenue.

News of the Trade.

THE NOVELTY INCANDESCENT LAMP COMPANY, St. Mary's, Pa., has completed its new plant for the manufacture of Elk new and Novelty refilled lamps.

W. T. PRINGLE.—The business of W. T. Pringle, of Philadelphia, has been transferred to the Pringle Electrical Manufacturing Co., Inc. Business will be carried on at the same address as before, 1906-8 North Sixth St., that city.

CALIFORNIA ELECTRICAL WORKS, of San Francisco, announce the opening of a Seattle branch about August 1. The temporary office there is now located at 439-40 New York Block, in charge of Mr. P. J. Aaron, to which point all orders and inquiries relative to the northwest territory should be sent. A complete stock of electrical supplies will be carried there.

THE AMERICAN CONDUIT MANUFACTURING COMPANY.—In our issue of May 19 we called attention to the fact that the Underwriters' Laboratories of Chicago had started their factory inspection service in a number of factories the names and addresses of which were given in the item. To the list on unlined conduit should be added the name of the American Conduit Mfg. Company, of Pittsburg, Pa., which, for some unaccountable reason, was omitted.

THE ABNER DOBLE COMPANY announces that it has relocated its offices at its former site, Fremont and Howard Sts., San Francisco. The company is one of the first to resume operations in the burned district, and has taken contracts for a large amount of work in addition to the orders on hand previous to the fire. Work is progressing rapidly on the company's new shops and warehouses in the Potrero district at Seventh and Hubbell Streets. Temporary pattern and forge shops are already in operation on the new site.

THE ELECTRICAL INSTALLATION COMPANY, Monadnock Building, Chicago, has been awarded a contract for the power house and substation buildings and equipment, all overhead electrical construction and rolling stock for the Indianapolis-Crawfordsville & Western Traction Company's line, 45 miles. Allis-Chalmers Company's steam and electrical machinery and car equipment will be used. The company has opened offices in the Traction Terminal Building, Indianapolis, Ind., where the engineering and direct supervision of the construction and equipment of the Indianapolis, New Castle & Toledo Electric Railway Company's system and the Indianapolis, Crawfordsville & Western Traction Company's line will be managed.

THE ONEIDA COMMUNITY, LTD., Oneida, N. Y., are now putting out a chain for the suspension of incandescent lamps for street work. This chain is of the same construction as their No. 1 Oneida galvanized chain commonly used for the suspension of arc lamps, and has the strength, durability and flexibility that is characteristic of No. 1 chain. This size used is termed No. 5, and is made from the best open hearth steel, being heavily galvanized at their own plant by the hot galvanizing process. This material will prove of interest to central station men for suspending incandescent lamps in the middle of the street, and a sample length sufficient for the suspension of one lamp is furnished free of charge to any manager desiring to test the chain.

THE VAN DORN & DUTTON COMPANY, of Cleveland, Ohio, has increased its capital stock from $50,000 to $150,000 to cover extensive improvements to its plant. The improvements will consist of additional machinery and the erection of a large new building, which will be utilized almost exclusively in the production of gears. The new gear cutting machinery will be of the most improved type and it is asserted that the plant will be the most complete of its kind in the country. A considerable portion of the plant will be occupied by the Van Dorn-Elliott Electric Company, which is closely affiliated with the Van Dorn & Dutton Company, and is well known to the trade through the production of electrical supplies and for its repair work. One of the important improvements which will be installed for this company in the new plants will be a pneumatic outfit for impregnating armature and field coils.

THE ELECTRIC CABLE COMPANY, of 17 Battery Place, New York, has just placed orders with the American Railways Company, of Altoona, Pa., and with the Taluca Light and Power Company of Taluca, Tex., for Voltax compound, to be used in both cases for insulating purposes. Voltax is meeting with extensive sales among the railway, light and power companies of the United States, which use this material not only for insulating and waterproofing purposes, but in connection with underground conduit systems. It is claimed that the underground conduit system consisting of wooden troughs into which Voltax insulating compound is poured after the manner of the underground transmission systems which have been in use in Germany for several years, may be installed and maintained at a cost ranging to 33 per cent less than any other transmission system now in operation. No poles or other expensive equipment is required, and the low cost of the materials and the ease with which such an underground system may be laid is rapidly bringing it into favor not only with the railway and light companies but with exposition companies and State fairs, where pavements do not interfere with underground work. In order to fill the large orders which the Electric Cable Company has received during the past three months, its force at Bridgeport, Conn., has been tripled within the past three months.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JUNE 19, 1906.

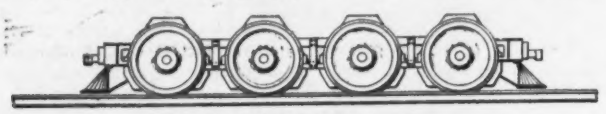
[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 140 Nassau St., N. Y.]

823,505. ELECTRIC SYSTEM OF TRANSMISSION; Charles G. Burke, Brooklyn, N. Y. App. filed Dec. 9, 1902. A telegraph system in which the line may be tuned in such a way that the charging period of the line corresponds in length to the period of the telegraph signals. Also provides means whereby the line may be used for a telephone or telegraph system.

823,513. SAFETY SYSTEM FOR OPERATING RAILROADS; William H. Damond, Detroit, Mich. App. filed Feb. 17, 1905. The track is provided with insulated sections which constitute receiving stations by which messages are transmitted to the train from points along the road. Also exhibits danger and caution signals in front of the train.

823,521. WEIGHT ACTUATED APPARATUS; Eugene Fuller, Arctic, R. I. App. filed May 15, 1905. A fire alarm device in which a hammer is operated to strike a bell by means of a heavy weight. The device is arranged to be automatically rewound by an electric motor.

823,542. FIRE ALARM; George H. Oatway and Charles E. May, London, England. App. filed Apr. 3, 1905. In order to make a hot wire alarm



823,968.—Electric Locomotive.

device more sensitive in use the patentee arranges the expansible wire between levers which are connected by an expansible rod. In this way the expansive effect of the rod is multiplied and added to that of the wire, which slackens and makes the alarm circuit.

823,560. ART OF METALLURGY; Enrique A. Touceda, Albany, N. Y. App. filed Jan. 28, 1905.

823,561. METALLURGICAL APPARATUS; Enrique A. Touceda, Albany, N. Y. App. filed Jan. 28, 1905.

823,566. DYNAMO ELECTRIC MACHINERY; William L. Waters, Milwaukee, Wis. App. filed Sept. 24, 1904. A construction for the attachment of lamanations to the pole pieces of a revolving field frame. The lamanations are held in place by transverse bolts and specially formed castings.

823,568. COMMUTATOR; William L. Waters, Milwaukee, Wis. App. filed Dec. 5, 1904. In order to more efficiently ventilate the commutator of a generator the segments are arranged in two series or groups thereby virtually forming two separate commutators.

823,569. BRUSH HOLDER; William L. Waters, Milwaukee, Wis. App. filed Jan. 20, 1905. Details of construction of a commutator brush having a frame with a pair of carbon brushes guided therein to have a normal movement against the face of the commutator. Each of the brushes is spring impelled by an adjustable bow spring.

823,579. TRANSMITTER-SUPPORT; Sidney A. Beyland, Elyria, O. App. filed Feb. 28, 1905.

823,642. COLLECTING BRUSH FOR ELECTRIC CURRENT GENERATORS AND MOTORS; Otto Siebers, Dresden, Germany. App. filed July 9, 1903. A composite copper brush having folded plates which are dovetailed together and enclosed within a metallic sheathing so as to form a unitary and resilient structure.

823,646. SIGNALING SYSTEM; Jacob B. Struble, Wilkinsburg, Pa. App. filed Feb. 12, 1903. A signaling system for railway employing an alternating current as a motive power and a rail of the track as a return for the alternating current, in which a closed track circuit is employed. Has a translating device which may in turn control a circuit including an operating mechanism for a signal device, comprised in a railway signal, or the translating device may directly operate the signal.

823,648. RAILWAY SIGNALING; Louis H. Thullen, Edgewood, Pa. App. filed Feb. 5, 1904. Relates to a signal system particularly adapted to railways over which electric cars are propelled, the motive power for the motors of which is alternating current, and with a return for the propulsion current through the rails. Has a source of direct current for energizing the rails of the block sections.

823,671. ELECTRIC WATER PURIFIER; Albert E. Dieterich, Washington, D. C. App. filed Apr. 10, 1906. A cylindrical housing contains a spiral casting having a pair of strips through which the current passes. The current of water is directed spirally between these strips where it is exposed to the electric action and the particles suspended therein precipitated.

823,682. SYNCHRONIZING MECHANISM FOR TIMEPIECES; Augustus L. Hahl, Chicago, Ill. App. filed Sept. 26, 1903. The escapement pallet is movable transversely so as to release the escapement wheel This movement is effective to position a stop in the path of an arm on the escapement wheel and corresponding to zero position thereof. The transverse movement is accomplished by a magnet energized by a circuit from the master clock.

823,724. ELECTRICAL RECEPTACLE AND PLUG; John C. Hatzel and Edgar L. Morley, New York, N. Y. App. filed Feb. 2, 1904. A plug or floor box having a chamber in which is received a porcelain block upon which the circuit wires are fastened and which automatically makes connection with certain spring blades when inserted into position within the housing.

823,758. SUPPORTING-ARM FOR TELEPHONE-TRANSMITTERS; Sidney A. Beyland, Elyria, O. App. filed May 12, 1904.

823,763. TELEPHONE-RELAY; Edward E. Clement, Washington, D. C. App. filed June 16, 1898.

823,768. TELEPHONE-TRANSMITTER; William W. Dean, Elyria, O. App. filed Sept. 13, 1904.

823,774. ELECTRIC SIGN; William Gierth and George Latimer, Jr., Newark, N. J. App. filed Oct. 20, 1905. An electric sign having lamps on both faces. Comprises a sheet metal box of which the front and rear sides are both removable. Bus bars are arranged within the box and extension connections may be made to the lamps on either side.

823,811. AUTOMATIC CIRCUIT MAKING AND BREAKING DEVICE FOR AUTOMOBILES AND THE LIKE; Andrew L. Riker, Bridgeport, Conn. App. filed Oct. 8, 1903. A vibrator for the ignition systems of automobiles. The contract spring is attached to the vibrator spring by a stud or link which permits a certain amount of lost motion between the two.

823,820. PRONG INSULATOR; Louis Steinberger, New York, N. Y. App. filed July 10, 1905. The insulator has a saddle shaped body of porcelain with a pair of overhanging edges or "spouts" which drain the water from the upper surface thereof. A double pronged hook projects from the upper part of the insulator through which the line wires may be engaged.

823,886. TELEPHONE; Thomas J. Merryman and Carl L. Allen, Lincoln, Neb. App. filed Aug. 25, 1904.

823,912. INSULATOR; August Biele, New Haven, Mo. App. filed July 25, 1905. The cross arms are drilled with circular holes through which the line wires pass and a cylindrical insulator is adapted to slip on to the wires and passed into said holes. Means are provided for holding the wire centrally in the insulator.

823,958. ELECTRIC ARC LAMP; Edwin J. Murphy, Rugby, England. App. filed Sept. 9, 1904. Details of an arc lamp having two carbons. Relates particularly to the construction of a pair of solenoids and a U-shaped cord therefor for positioning the electrodes and an auxiliary armature adapted to bridge the ends of the legs of said U-shaped core to impinge on the ends of the solenoids.

823,968. ELECTRIC LOCOMOTIVE; Edward D. Priest, Schenectady, N. Y. App. filed Jan. 28, 1905. Electric locomotive having four pairs of wheels on each of which is a direct connected motor. The invention relates particularly to a form of suspension by which the weight is evenly distributed on all of the wheels.

823,969. ELECTRIC LOCOMOTIVE; Edward D. Priest, Schenectady, N. Y. App. filed Jan. 28, 1905. Relates to modifications of the above, and particularly to a transverse suspension system for keeping the pole faces of the motor in parallelism with the armature.

823,973. INDUCTION COIL; Stanislaus H. Sauve, Spokane, Wash. App. filed May 23, 1905. An induction coil of the ordinary form is provided with a supplemental secondary winding the circuit of which is not closed, but which may be connected to a condenser.

823,979. AUTOMATIC AIR BRAKE; Friedrich J. R. Wagner, Berlin, Germany. App filed Dec. 9, 1899. An engineer's valve having the usual air passages and electric segments which complete electric circuit to special magnet operated valves.

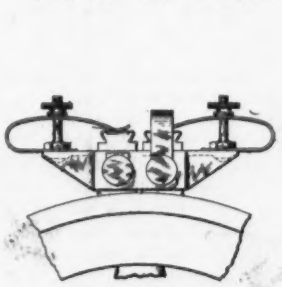
823,984. LOCKING AND TRIPPING DEVICE FOR SWITCHES; Harry M. Acly, Pittsfield, Mass. App. filed Nov. 17, 1904. Details of a magnet circuit breaker or cut-out having a switch element which is normally pressed into circuit closing relation by a toggle jont, but which may be tripped so as to open the circuit by a magnet acting on the toggle joint to destroy the alignment of the links thereof.

824,003. WIRELESS TELEGRAPH SYSTEM; Lee De Forest, New York, N. Y. App. filed Feb. 20, 1906. Designed to provide a coupled wireless telegraph system whose natural mode of vibration shall be monoperiodic, and which shall have a greater persistency of vibration than those now commonly employed. Has two paths from the top of the entenna to earth which are equal in natural period, a spark gap associated with said circuit, and an auxiliary shunt path containing a capacity connected across said spark gap.

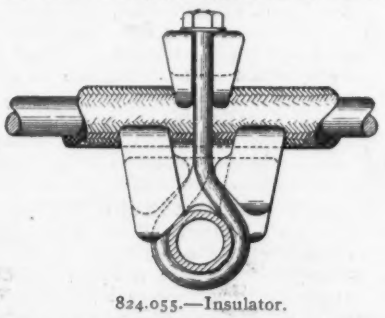
824,015. THERMO-ELECTRIC COUPLE; Harry E. Heath, Lynn, Mass. App. filed Aug. 7, 1905.

824,021. RECEPTACLE FOR ELECTRIC LAMPS; Paul H. Jaehnig, Newark, N. J. App. filed May 4, 1904. Construction of water-proof socket having a base block with passages therein in which the connections are made by means of metallic clips. The passages are afterward filled with cement in order to make the receptacle water proof.

824,028. TELEGRAPHIC SENDING DEVICE; Isidor Kitsee, Philadelphia, Pa. App. filed Jan. 27, 1903. Telegraph apparatus having an



823,569.—Brush Holder.



824,055.—Insulator.

automatic receiving element and having a transmitting or sending element which, while it affords the necessary variety of signals, is very simple in manipulation. Has a series of movable members provided with a series of lines of raised characters, each of said lines designating a numeral of different value.

824,030. TELEPHONY; Isidor Kitsee, Philadelphia, Pa. App. filed July 23, 1904.

824,031. TELEGRAPHIC TRANSMITTING KEY; Isidor Kitsee, Philadelphia, Pa. App. filed Feb. 11, 1905. A transmitting key having a lever depending from a fixed point by means of a resilient spring, and arranged to swing between contacts so as to complete circuits of alternate polarity by successive movements.

824,029. TRANSMITTING KEY FOR TELEGRAPHIC CIRCUITS; Isidor Kitsee, Philadelphia, Pa. App. filed Mar. 25, 1904. Designed to secure the current reversals of a transmitter for a submarine cable through a simple Morse key. The key operates a relay in the form of an escapement wheel which alternately makes the circuit from a positive and from a negative battery pole.

824,032. TELEPHONY; Isidor Kitsee, Philadelphia, Pa. App. filed Apr. 10, 1905.

824,046. ELECTROMAGNET; Charles F. A. Sturts, San Francisco, Cal. App. filed Apr. 28, 1905. A construction of electromagnets designed for the winding mechanism of clocks. Two magnet poles act on an armature pivoted between them so as to swing the same in a direction to wind up an escapement wheel.

824,048. INSULATED COIL FOR ELECTRICAL APPARATUS AND PROCESS OF MAKING THE SAME; Elihu Thomson, Swampscott, Mass. App. filed Sept. 11, 1903.

824,055. INSULATOR; Harry M. Alcy, Pittsfield, Mass. App. filed Nov. 12, 1904. A construction of insulator for large cables which are designed to be supported from horizontal supporting pipes. Includes porcelain blocks which are placed between the parts and held in position by metallic wires or straps.

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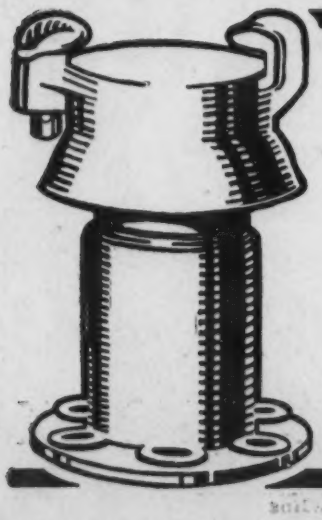

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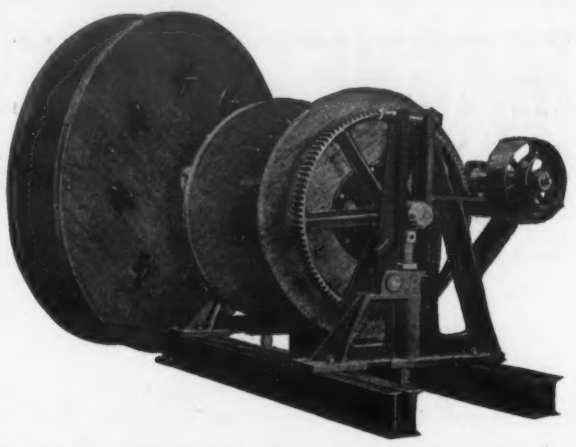

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Positively Won't Shake Loose
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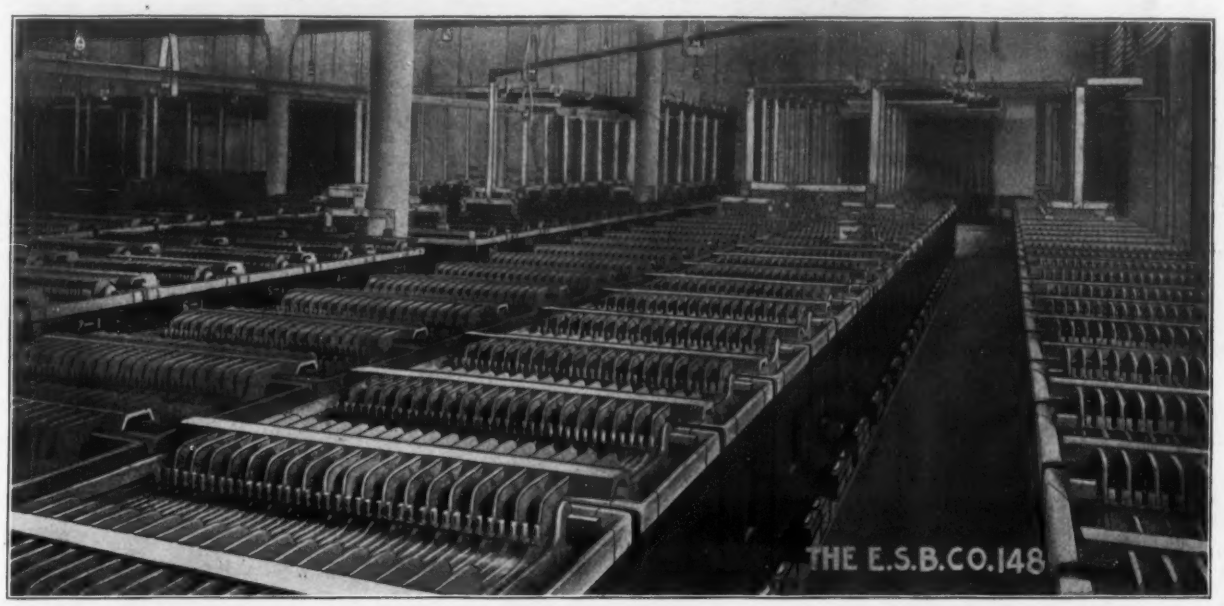

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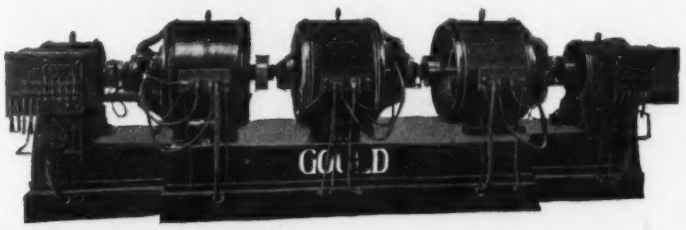

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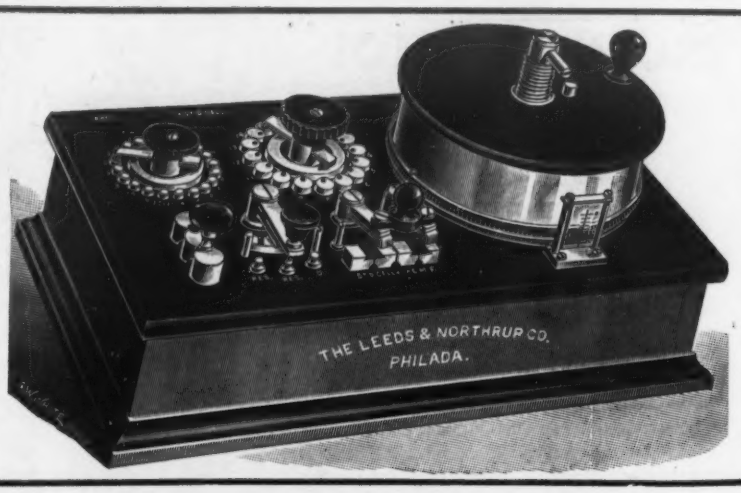

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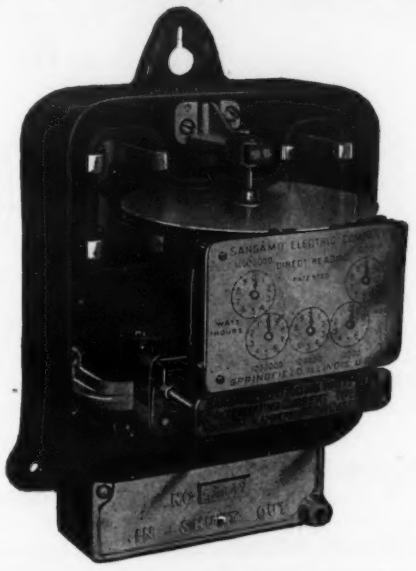

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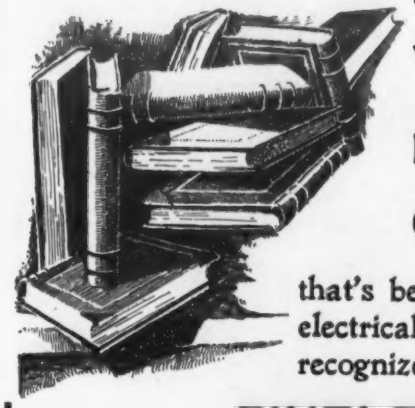

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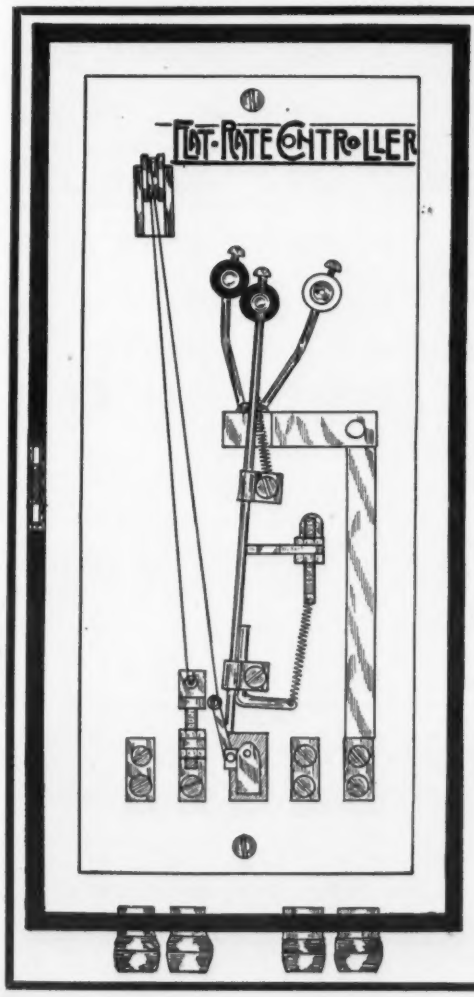

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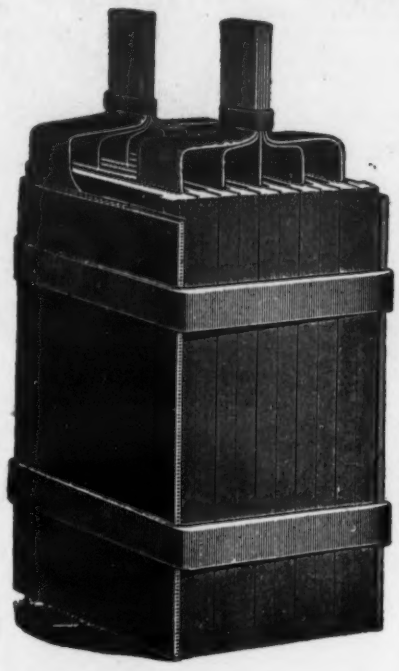

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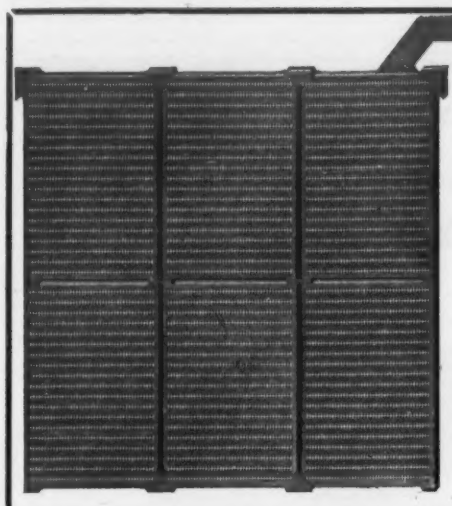

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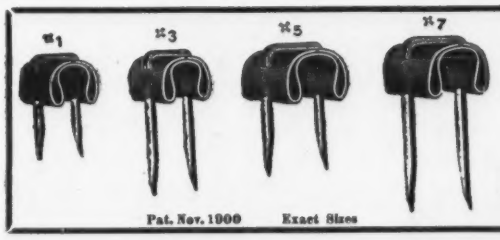

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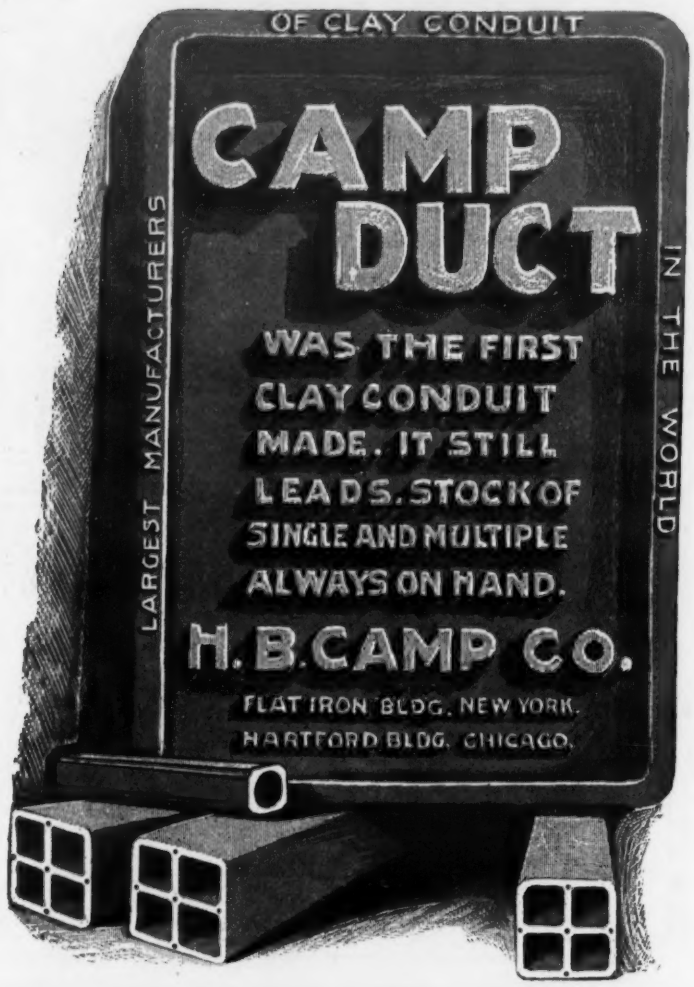
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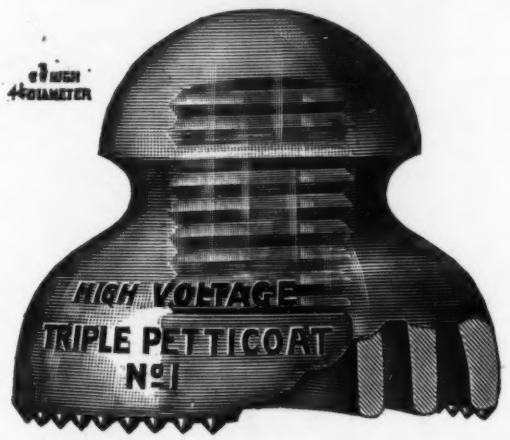

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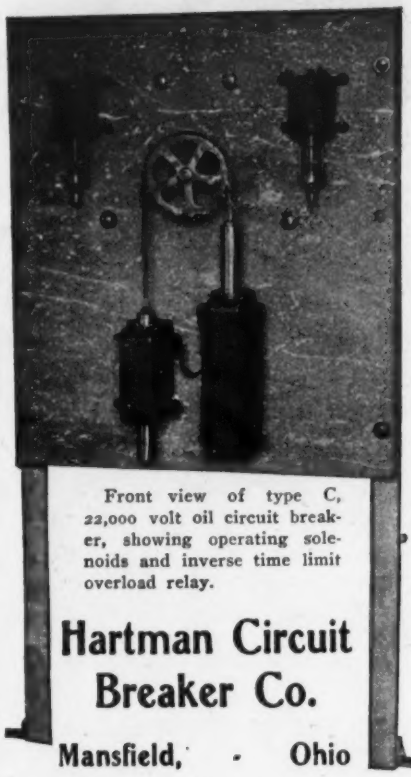

Front view of type C, 22,000 volt oil circuit breaker, showing operating solenoids and inverse time limit overload relay.

Hartman Circuit Breaker Co.

Mansfield, - Ohio

can be installed on a marble panel as shown above, or on the wall of the switch room. The operating current is derived from the exciter, a storage battery or any convenient source of direct current supply. The operating solenoids can be wound for any standard voltage.

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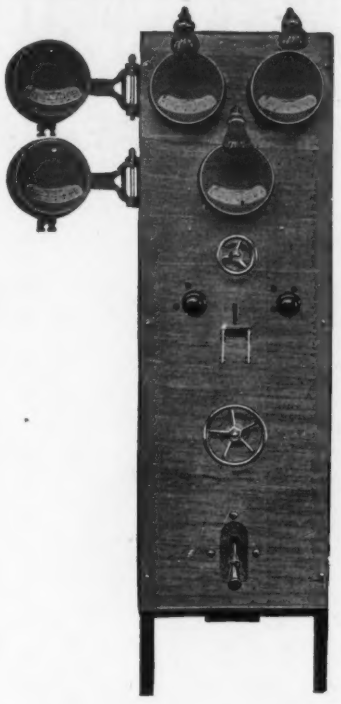

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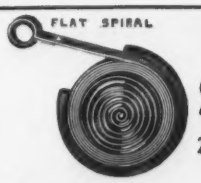

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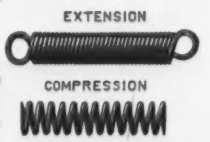

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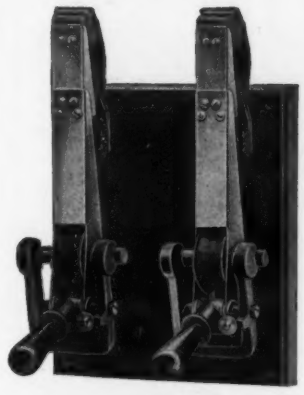

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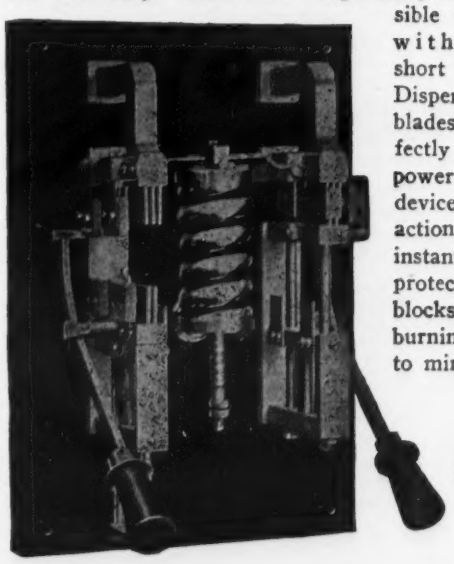

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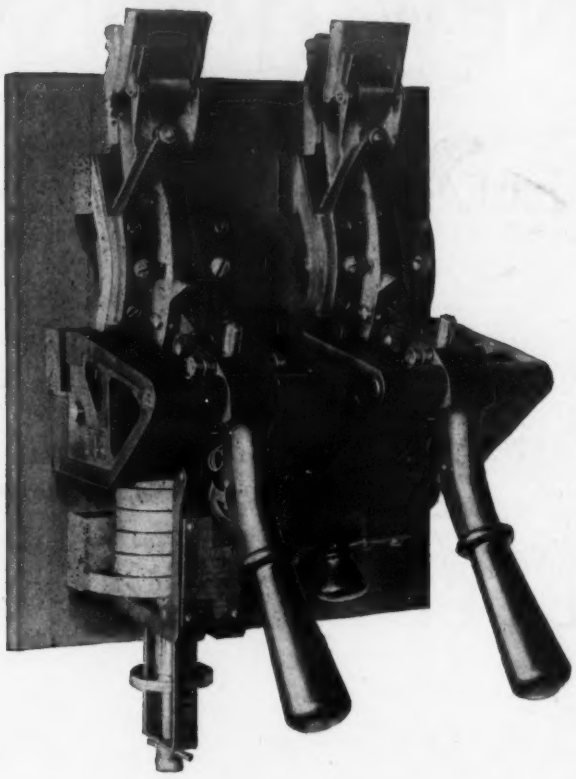

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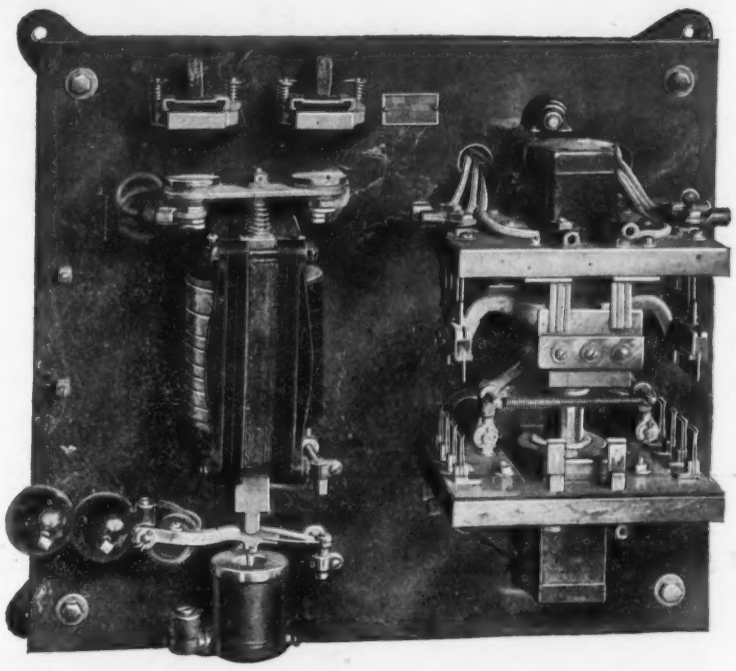

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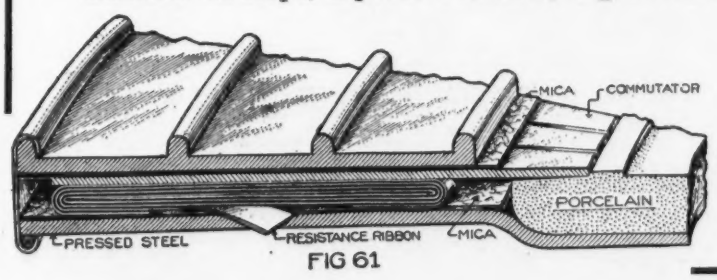

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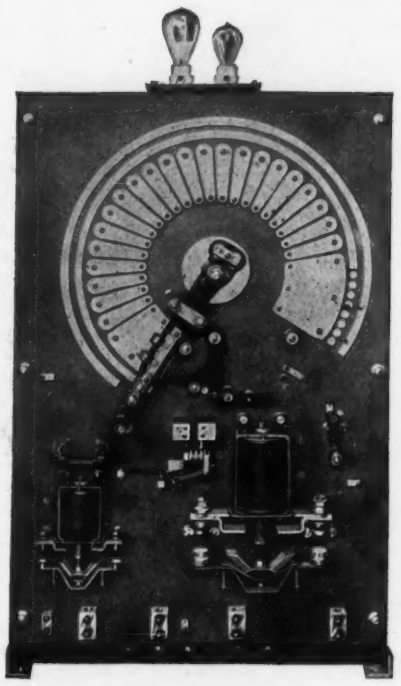

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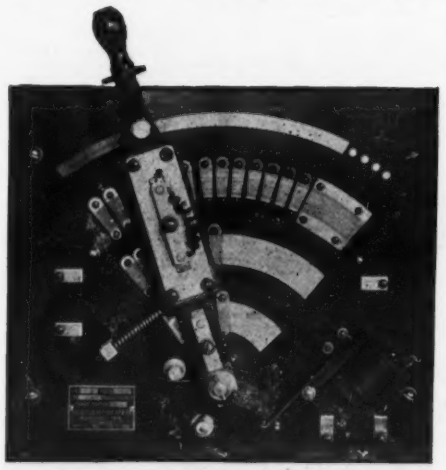

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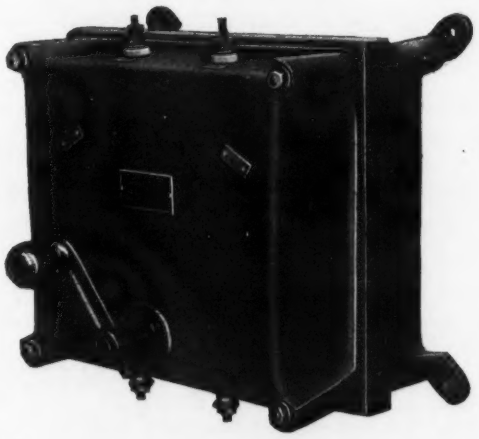

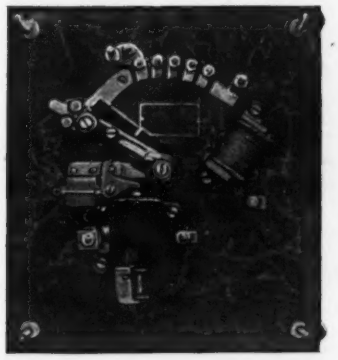

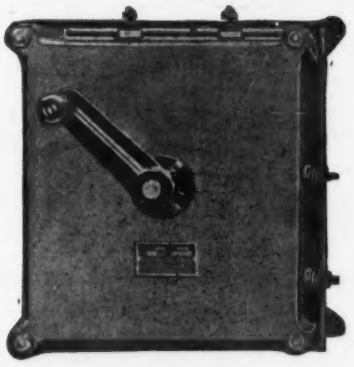

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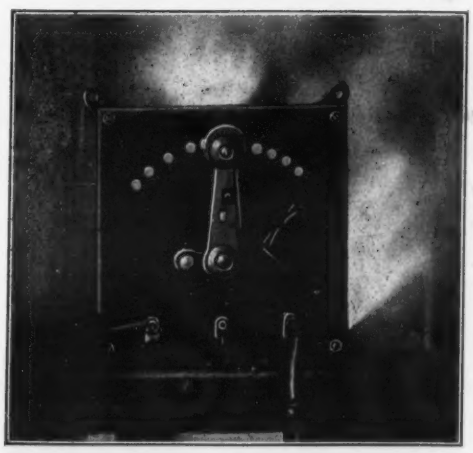

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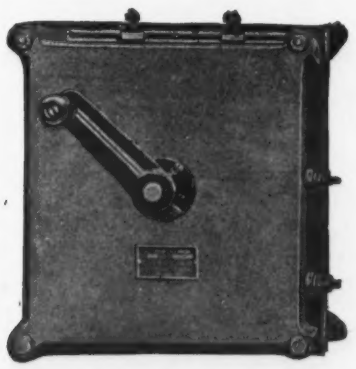

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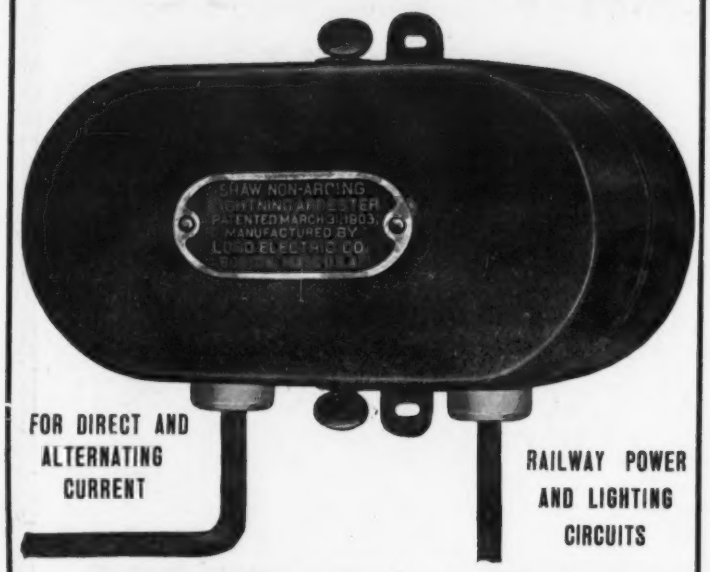

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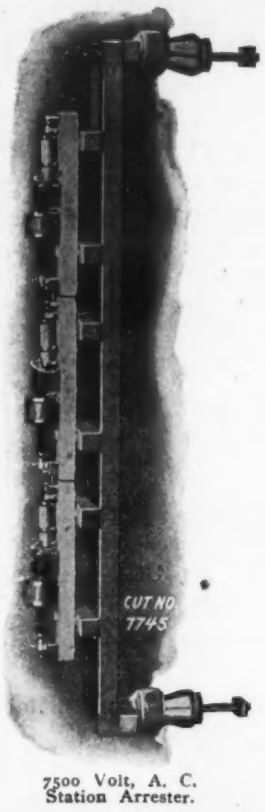

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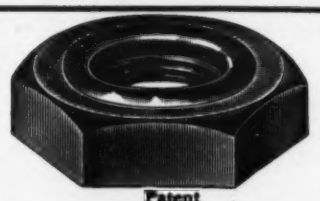

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If once used always used, for they absolutely remove all strain from socket connections and grip number 16 or 18 new code cord; also serve as a socket bushing or insulator.

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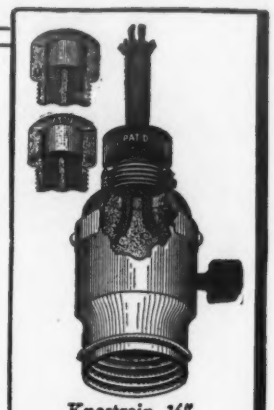
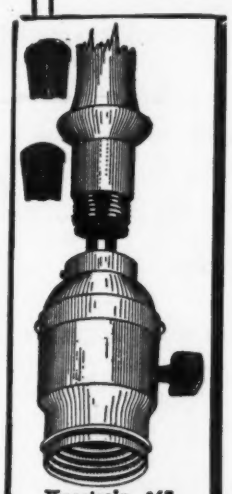


Knostrain ⅜" Socket Bushing.



Knostrain ⅜" Handle Bushing.

Prices quoted on application

FRANK H. STEWART ELECTRIC CO.

35 North 7th St. Philadelphia.

For Sale by All Leading Supply Houses

Hubbell

Wire Lamp Guard

Excels in simplicity, rigidity and appearance.

2 Sizes:

16 c. p.

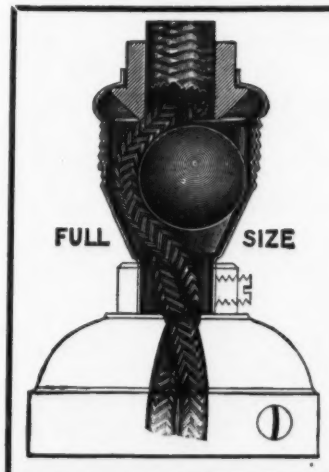
32 c. p.

Attached firmly to socket shell by means of a screw collar. Does not depend on lamp bulb for support.

Harvey Hubbell, Inc.

Main Office and Factory - BRIDGEPORT, CONN.

New York Chicago San Francisco



KEOUGH

Cord Grip

Permits the Use of

LARGEST SIZE

REINFORCED CORD

WITH

⅛ in. SOCKET

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KEOUGH BROS. & CO.

79 North St. Boston

It will save you money to INVESTIGATE our

Universal Electric Light Holders

before installing, enlarging or reparing your lighting equipment.

They are the best and lowest priced holders on the market. Particularly adapted to shops, drafting offices, etc.

Send for prices and sample on approval. State height of ceiling.

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BENJAMIN WIRELESS CLUSTERS AND LIGHTING SPECIALTIES

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NEW YORK CHICAGO SAN FRANCISCO

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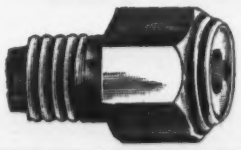
FUSELESS PORCELAIN ATTACHMENT PLUG



Extra heavy porcelain, hard to break, poles separated by a solid wall of porcelain, which, with other features, protects short circuits. See booklet for other specialties and panel boards.

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The Profits of Lighting Homes

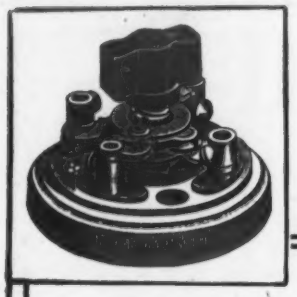
depend upon the energy with which the station tempts the consumer to increase the use of current. Many stations have built up a good increase in sales by showing and offering on easy payments an attractive line of electric portables, newals and electroliers. We have the goods and a plan for booming the sale of current.

Why not let us tell you?

The Goodwin & Kintz Co.

Station C

WINSTED, CONN., U. S. A.



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Purchasers are Satisfied

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"Diamond H" Switches

Made in many types but of only one quality—the best always.

THIS MARK TRADE MARK GUARANTEES

The Hart Mfg. Co.

HARTFORD, CONN.

New York Boston Chicago Toronto, Ont. London, Eng.

National Electrical Code Standard

CUT FULL SIZE

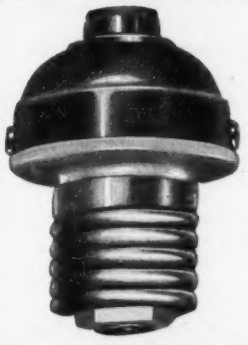
THE SARCO PENDANT SWITCH

Will take either reinforced or regular cord; interchangeable bushing furnished with it.
Impossible to burn out on rated capacity
No side screws to get lost.
Absolutely fool proof.
No side buttons to break off.
For Arc Lights—Better than Ceiling Switch, ¼ the Cost.

THE SARCO CO.

906 Sixth Ave. New York

Wide Awake Buyers are Quick to Take Advantage of a Good Article



Our Brass Cap Attachment Plugs are unexcelled.
Bushings large enough to take re-enforced cord.
Special features in insulating brass cap.
Screw shell fits tight to porcelain with hexagon piercing to prevent turning. Price, .08.
Special figures in quantities.
Special prices on Edison Cut-outs, W. P. Sockets, Fuse Plugs, Etc. Before making contracts or placing your order, write us for prices. We are certain they will interest you. It will save you time and trouble.

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Help Your Profit Account

By increasing sales of current.
Our Eureka Electric Sad Iron

with its unburnable heater, we have perfected by adding a spring cord protector, making the cord practically unbreakable and unwearable and fitting it for home or workroom use.

We have the best Electric Curling Iron Heater on the market.

These are Current Sellers and their evident convenience will bring you new customers.

We have a selling plan to suggest, an interesting catalog and special central station prices at your service.

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Cleveland, Ohio

FREEMAN'S

BRASS CAP ATTACHMENT PLUG.

No notches in cap to hold lining in. Smooth bushing for cord. Will bottom in Weather-proof Socket. Will take re-inforced cord. Porcelain extra strong. Prices Reasonable. Send for Sample and Prices.

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ELECTRICAL HEATING APPARATUS

OF EVERY KIND FOR EVERY PURPOSE

AMERICAN ELECTRICAL HEATER CO,

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LOOK FOR THIS ON THE PACKAGE ALLEN GET THE HABIT

WHEN YOU USE SOLDERING SALTS, USE ALLEN'S

If you don't happen to know how good it is, send your dealer's name and we'll send you a free sample, then you *will know how good it* is.

L. B. ALLEN CO., Inc.

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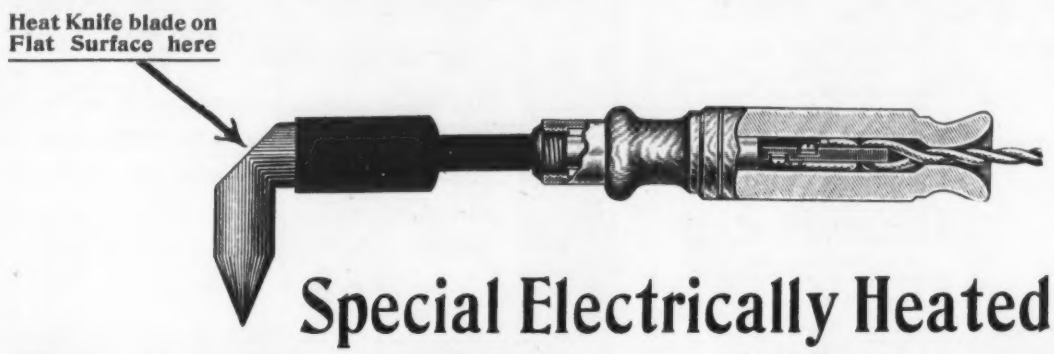

Special Electrically Heated

Tool For Waxing Electrotypes

Better, Cheaper and more convenient than the usual gas outfits

MANUFACTURED BY

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Chicago

TRADE VULCAN MARK

NOW IS THE TIME

when the *Simplex Electric Chafing Dish* is extremely popular for serving tempting delicacies. After serving, the upper part may be removed and the electric heater used for percolating the coffee.

Safer, cleaner and less expensive than with alcohol or other methods. It connects to any incandescent lamp socket and operates quickly by turning the switch.

"SIMPLEX QUALITY"

Sizes and styles to suit requirements. Sold direct or through dealers.
Send for Illustrated Catalog and Price List G, "Electric Heating."

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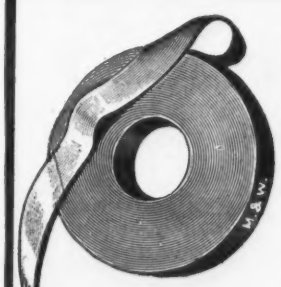
CAMBRIDGEPORT, MASS.

No. 1205—List Price $16.00



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A postal request will bring samples post-haste.

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MORGAN & WRIGHT TAPE IS GOOD TAPE

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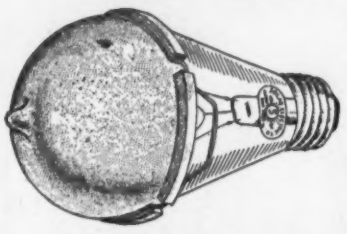
Made of Natural Colored Glass



Easily removed to renew lamp or change color.

Adds novelty and beauty to

ELECTRIC SIGNS, SHOW WINDOWS

And all kinds of

ELECTRIC DISPLAYS

4, 8 and 16 c. p. sizes
Ruby, Blue, Green and Amber Colors

Write for prices

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The "Geryk" Vacuum Pump

Pieces Patent

Giving a vacuum comparable with that obtained by the Sprengel pump. In use in the principal lamp factories in the U.S.A. and Europe for lamp exhausting and flashing purposes.

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Incandescent Lamps
Every Type & Voltage

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TO YOUR BUSINESS MEN

We allow liberal discounts to dealers. Write to-day for particulars and prices, also pointers on electric designs.

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QUEEN COMPOUNDS

For coloring or frosting lamp bulbs are unequalled. Make dipped lamps good as the natural colored glass. Brilliant effects.

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Look for the Blue Glass on the Stem

An Assurance for the Reliable

Jaeger Miniature Lamps

Made of every known description. For every known purpose.

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THERMO-BLINK

LIST PRICE, $1.50 EACH

Motorless Flasher No. 1 for alternating or direct current. Flashes from 1 to 4 sixteen candle-power lamps. The only real electrical flasher ever made. Not an adaptation. Does just the work it is designed for.

If interested in signs, write for our new catalogue.

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THE METROPOLITAN ENGINEERING CO., Brooklyn, New York.

"The Greatest Electrical Sign Builders in the World"

Electric Signs, Flashers, Time Switchs and Photometers

Send for Sign-Book and handsomely illustrated Bulletins.

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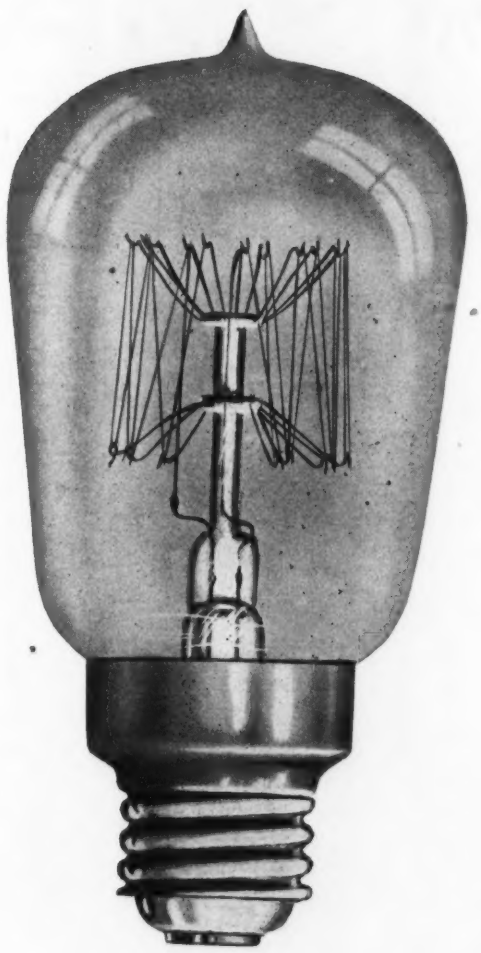
TANTALUM

EFFICIENCY
2 Watts to each Horizontal C. P.

CANDLE POWER
22 C. P. Horizontal
5 C. P. Vertical

Reflectors to direct light in useful direction



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Average 700 hours on direct current

FROSTED OR CLEAR GLASS

VOLTAGE
from 100 to 130—or in series on circuits 200 to 250 volts

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Total Watts per Lamp 44

The Shelby Electric Company
Shelby, Ohio

All Cities

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The Buckeye Electric Co.

Announced and First Exhibited

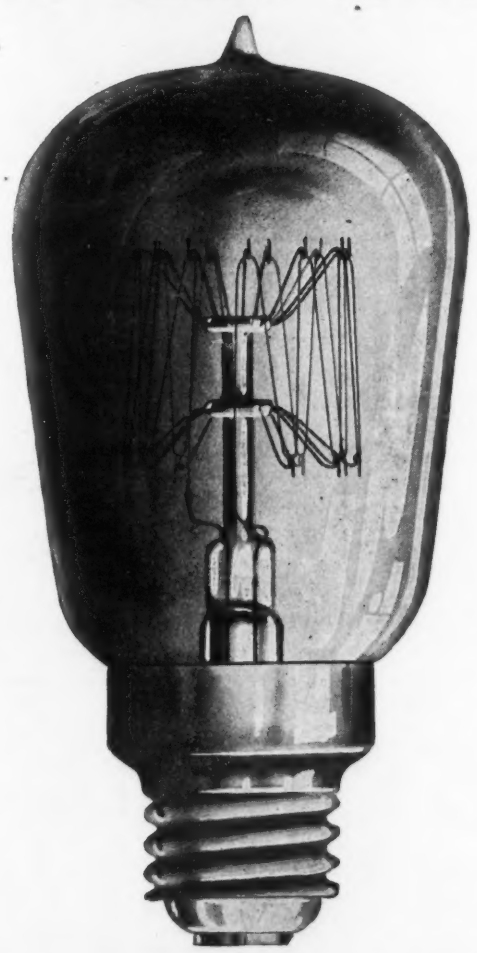
The TANTALUM LAMP

At the Atlantic City meeting of the N. E. L. A.

WE ARE NOW READY TO FILL ORDERS

Voltages from 105 to 125

Direct Current Circuit Only



LOOK FOR THE LICENSE LABEL IN THE STEM

LOOK FOR THE LICENSE LABEL IN THE STEM

Highest Possible Commercial Efficiency

Approximately 22 C. P. —2 watts per candle with an average life of 700 hours

THE BUCKEYE ELECTRIC COMPANY

Main Office and Works, CLEVELAND, O.

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A BUM LAMP

is what the Bowery boy would call this discolored optic. If the other fellow was too much for you and one of these mourning emblems was handed out to you, you would probably agree with the boy.

Now About Incandescent Lamps

We will drop the "bum" ones and tell you about a good one—the

BOSTON RENEWED INCANDESCENT LAMP

It lasts Longer, Lights Better, Costs Less and has a positive guarantee with every lamp. If you're onto your job, you'll join the wise ones and try a bunch of Boston Lamps, and--you'll try your hand at annexing this fine Boston Terrier whose portrait goes with this ad.

He's yours if you work for a central station or isolated plant and send us the best advertisement or suggestion for advertising Boston Lamps. Now get busy—and good luck to you!

Boston Incandescent Lamp Co.

Danvers - Mass.

Look for the next issue.

"Excello"
"Sunray"

"The Light that never Fails"

The Excello Arc Lamp Co.

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Tel. 1595 Gramercy

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STANDARD
DIRECT CURRENT

FACTORY LAMPS

Made to withstand rough usage

IMPORTANT FEATURES
Indestructible Magnets
Accessible Parts
Simplicity of Construction
Low Cost

Manufactured by
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For Suspending
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Manufactured by
ONEIDA COMMUNITY, Ltd.
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From a consulting engineer:

"It goes without saying that the Electrical World is the best journal in the electrical field."

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For all types of
ENCLOSED ARCS

ELECTRA
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For all types of
FLAMING ARCS

UNEQUALLED FOR LIFE AND LIGHT BY ANY OTHER CARBON

HUGO REISINGER, SOLE IMPORTER

11 BROADWAY NEW YORK

ELECTRA CARBONS

BECK FLAMING LAMPS

Price $30.00

3000 to 5000 Candle Power.

GIVE THE MOST LIGHT

FOR

THE LEAST CURRENT and MONEY

Has no regulating mechanism.
The Simplest Arc Lamp ever built.

Manufactured by

BECK FLAMING LAMP CO.

Office and Laboratories, 58 West 15th St., New York City
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SIEMENS SPELLS SUCCESS

Here are three successful Siemens products:

FLAMING ARC LAMPS

EACH of these lamps gives, with 12 amp. on the series, on 110 v. circuit, from 6 to 7 times more light than an ordinary enclosed arc lamp.

No lower carbon holder to intercept light.

By proper choice of carbons, golden yellow, pink or pure white light can be obtained.

ECONOMY LAMPS

A DISTINCT novelty for D. C., 5 amp. on 110 v., giving 760 mean hemispherical c.p. Life of carbons, 27 hours.

Extremely graceful, medium in size, suitable for indoor or outdoor illuminating.

Write for details.

LILIPUT LAMPS

THE smallest arc lamp on the market, the most symmetrical. Unparalleled for indoor or outdoor use anywhere.

For D. C. 2 and 3 amp, 170 and 335 mean hemispherical c.p. (maximum c.p. 325 and 570, respectively). Life of carbons, 16 and 12 hours, respectively.

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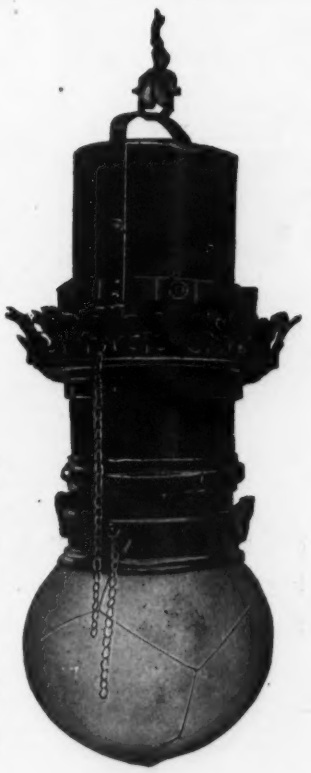
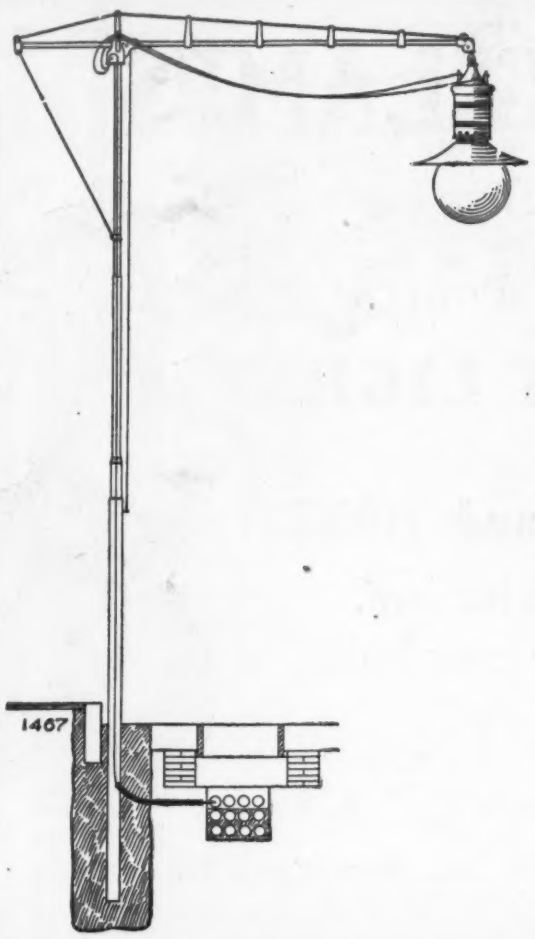


Felix Hamburger, 78 Fifth Ave., New York



Type U B Mast Arms

For Underground Construction

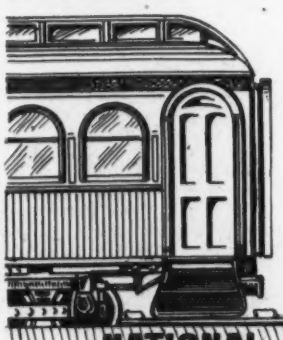
Simple.
Durable.
Neat in appearance.
Built entirely of iron.
Wires leading from conduit reach the lamp through the hollow upright. See cut.
The lamp, in trimming drops down close to the sidewalk, out of the way of passing vehicles and street cars.
When equipped with our Sure Grip Pulley it is one of the safest of mast arms.
We make other types of mast arms to meet any condition of service.

Send for bulletin 1037.

Fort Wayne Electric Works

"Wood" Systems
Fort Wayne, Indiana 446

HOME FROM THE CONVENTION



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If not---we would like to

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NATIONAL CARBON COMPANY, CLEVELAND, OHIO

Consulting and Contracting Engineers,
Electrical Engineers of all classes,
Superintendents of Electric Lighting Stations
Superintendents of Telephone Exchanges,
Superintendents of Electric Street Railways,
Large Manufacturers, Dealers and Importers of Electrical Apparatus

In all parts of the world are reading
ELECTRICAL WORLD

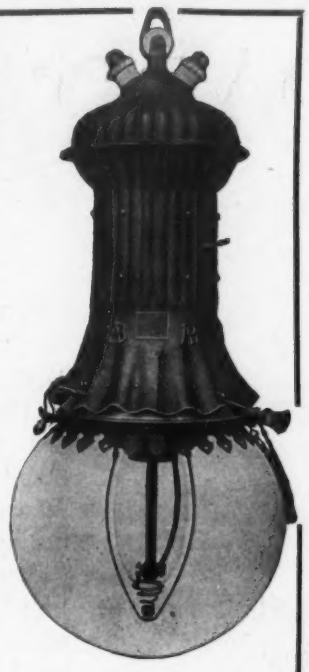
STURGESS WATER WHEEL GOVERNORS

Write for Information on Our
New Vertical Type.
The Finest Governor Ever Built.

Sturgess Engineering Department
THE LUDLOW VALVE MFG. CO.,
Troy, N. Y.

Here's what makes

A-B ARC LAMPS



the lamps chosen by those who examine carefully:—

Hard rolled stamped sheet copper, weather-proof case.

Door in case for access to inside mechanism.

Porcelain insulations for hanger and binding posts.

Strong, heavy hand switch, carefully designed air pot. Cup-shaped inner globes, flexibly supported against ground seat, single negative rod for lower carbon holder support, ease of trimming, adaptability for hot trimming.

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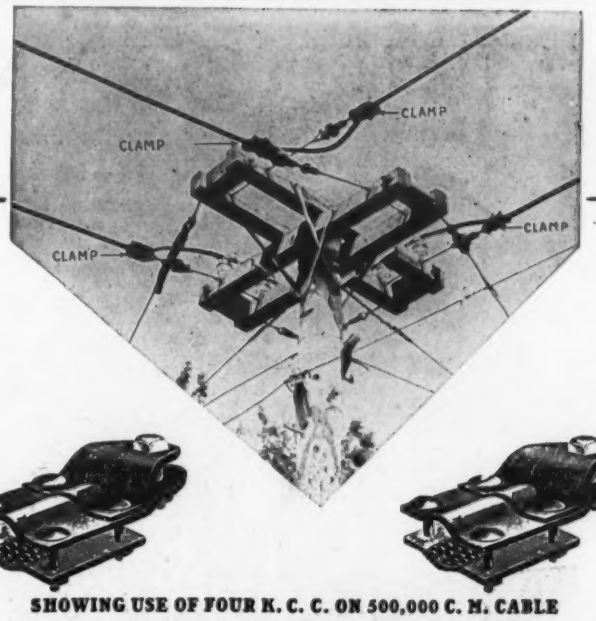
The Adams-Bagnall Electric Co.

CLEVELAND

New York Office 136 LIBERTY ST. — **OHIO** — **Chicago Office** 303 DEARBORN ST.



SHOWING USE OF FOUR K. C. C. ON 500,000 C. M. CABLE

USE KEARNEY CABLE CLAMPS

Supposing Kearney Cable Clamps cost a nickel each; you would be apt to order a few just to see if they were any good for supporting cables, wouldn't you? Because the risk would be small. Well, if we make you a proposition to lay 25 or more K. C. C. down in your city free of all expense to you and give you 30 days to test them out with the understanding that you don't have to pay for them unless you want them, isn't this better? You don't have to spend a nickel unless Kearney Cable Clamps will save you money over the methods you are now using. Kearney Cable Clamps afford the simplest means of relieving the strain on cables at corner poles, curves and dead ends. They make a stronger, better and neater job.

WHY NOT SEND US YOUR ORDER AS OUTLINED ABOVE

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Manufacturers

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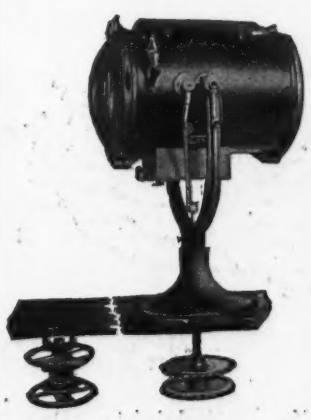
Eastern Office: 227 TAYLOR BLDG., Cortlandt St., New York



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for

Distant Control

All Sizes

Brass or Iron

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Vacuum Drying and Impregnating Apparatus

FOR ARMATURES, ELECTRIC CABLES, MAGNET COILS, FIELD TRANSFORMERS

Norman Hubbard's Sons, 265-267 Water St., Brooklyn, N. Y.

VACUUM DRYING AND IMPREGNATING APPARATUS

Emil Passburg System

Electric Cables — Field Transformers
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Passburg Patents

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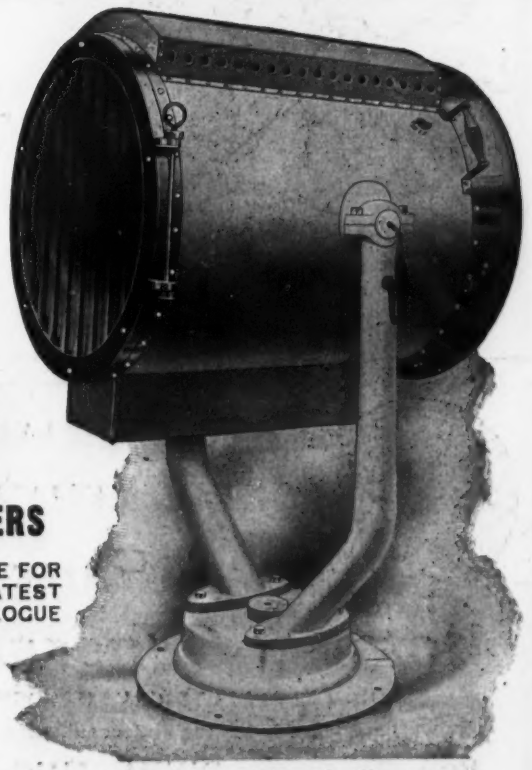
OVER 700 APPARATUSES IN USE

SEARCHLIGHT PROJECTORS



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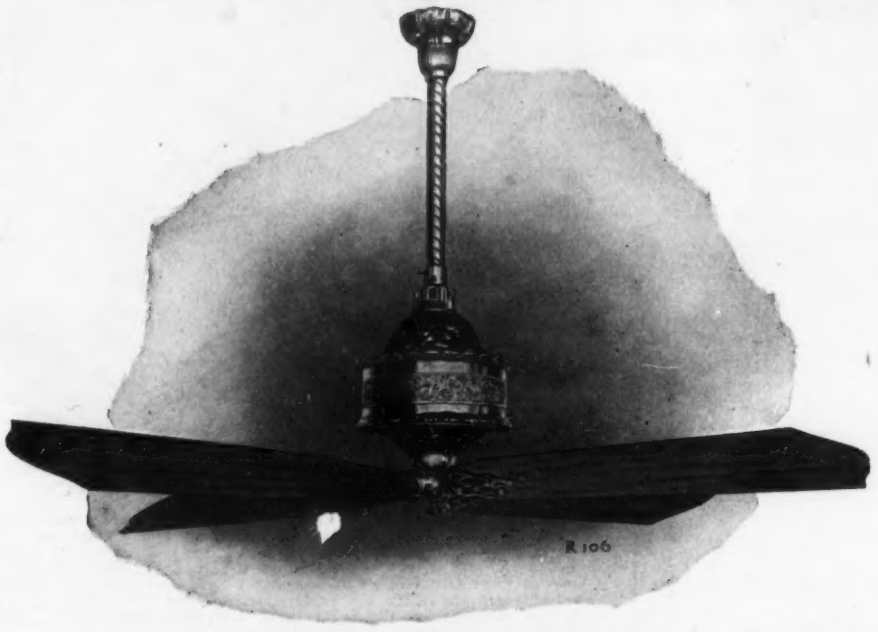
"THE STANDARD" FANS



Style "C."

This latest addition to "The Standard" line has the famous "Standard" insides, and will show all the wonderful power and durability that is the backbone of "The Standard" trade.

As a piece of artistic workmanship, the exterior of this new Fan is without reproach.

Finished in all the fine metal finishes, with satin mahogany finished bevel edged blades, 58-inch sweep, 200 r.p.m.

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Baltimore: 513 American Bldg.
St. Louis: 11th and Locust Sts.
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"RIBBONS SHOW WHICH WAY THE WIND BLOWS"

WITH

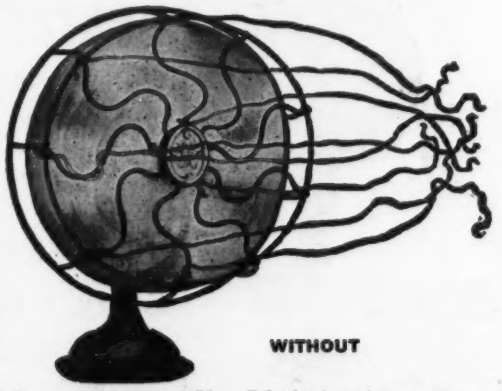
You get the air---but NOT the Direct DRAFT from the Electric Fan that is equipped with the *D'Olier* Air-Deflector.

Patented Nov., 1905

TWO SIZES.

For 12 in. Guard $1.50 each
For 16 in. Guard $2.50 each

SIMPLE, neat, easily attached, all one piece. They last the life of the fan and help keep the air circulating through the entire room. Send for our Air-Deflector Bulletin No. 25, just issued.



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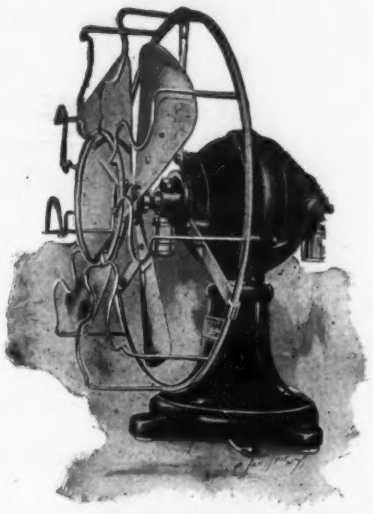

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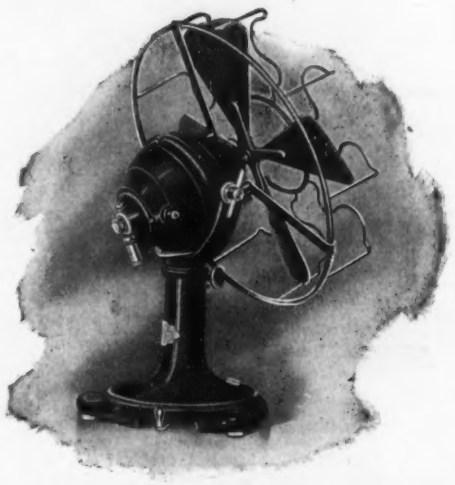
of acknowledged superiority for all desk, wall and ceiling requirements. Write for catalogue No. 3123



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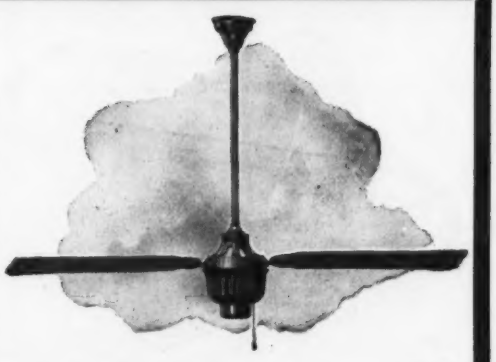

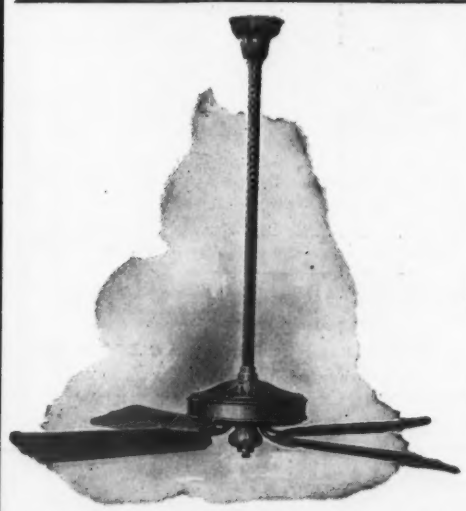

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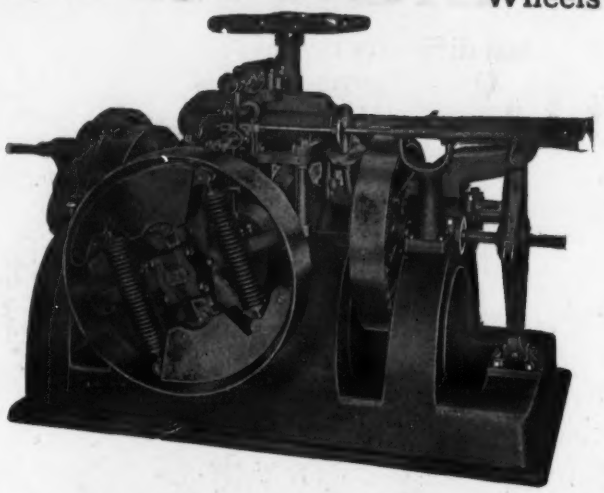

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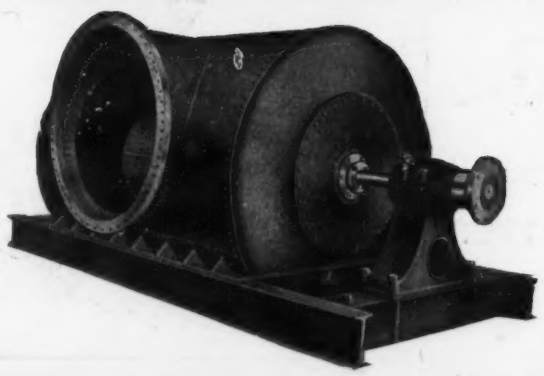

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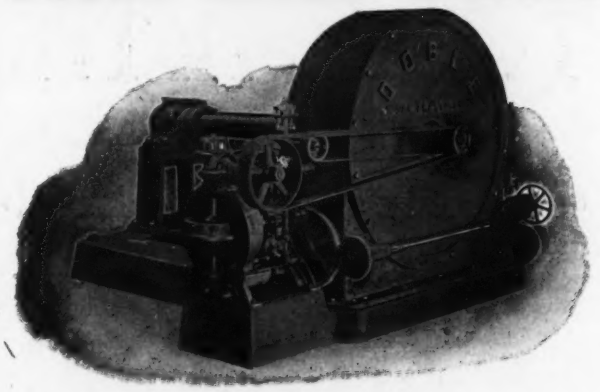

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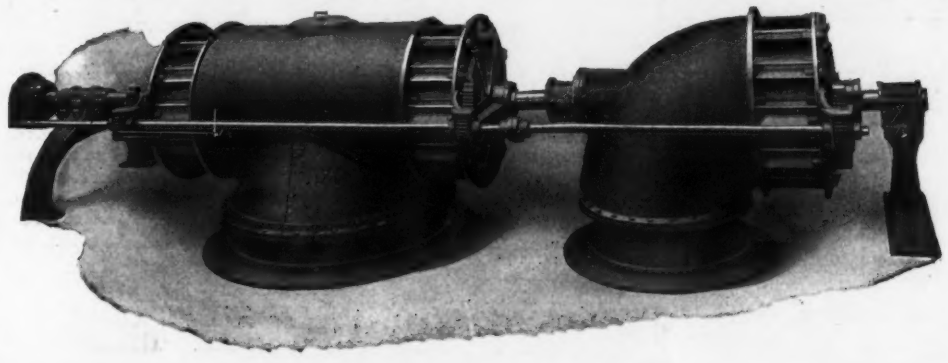

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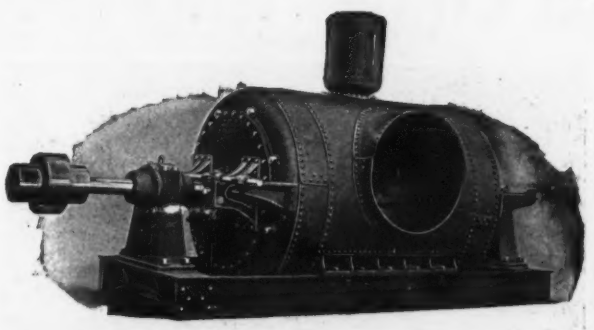

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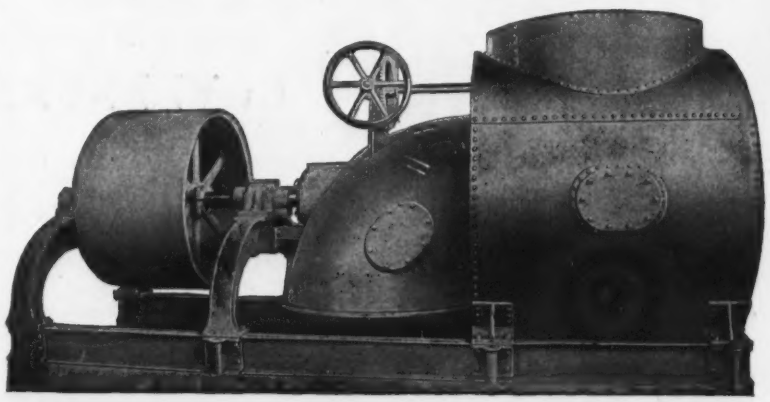

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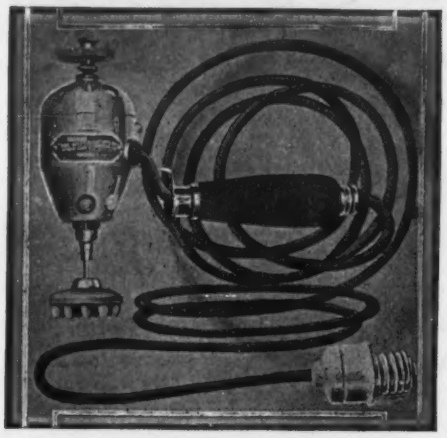

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Deafness	12.	Neuralgia	10.
Constipation	16.	Neurasthenia	20.
Dysmenorrhea	4.	Neurifis	10.
Enlarged Glands	8.	Partial Paralysis	16.
Goitre	8.	Rheumatism	16.
Hemorrhoids	8.	Sciatica	20.
Impotence	8.	Spinal curvature	4.
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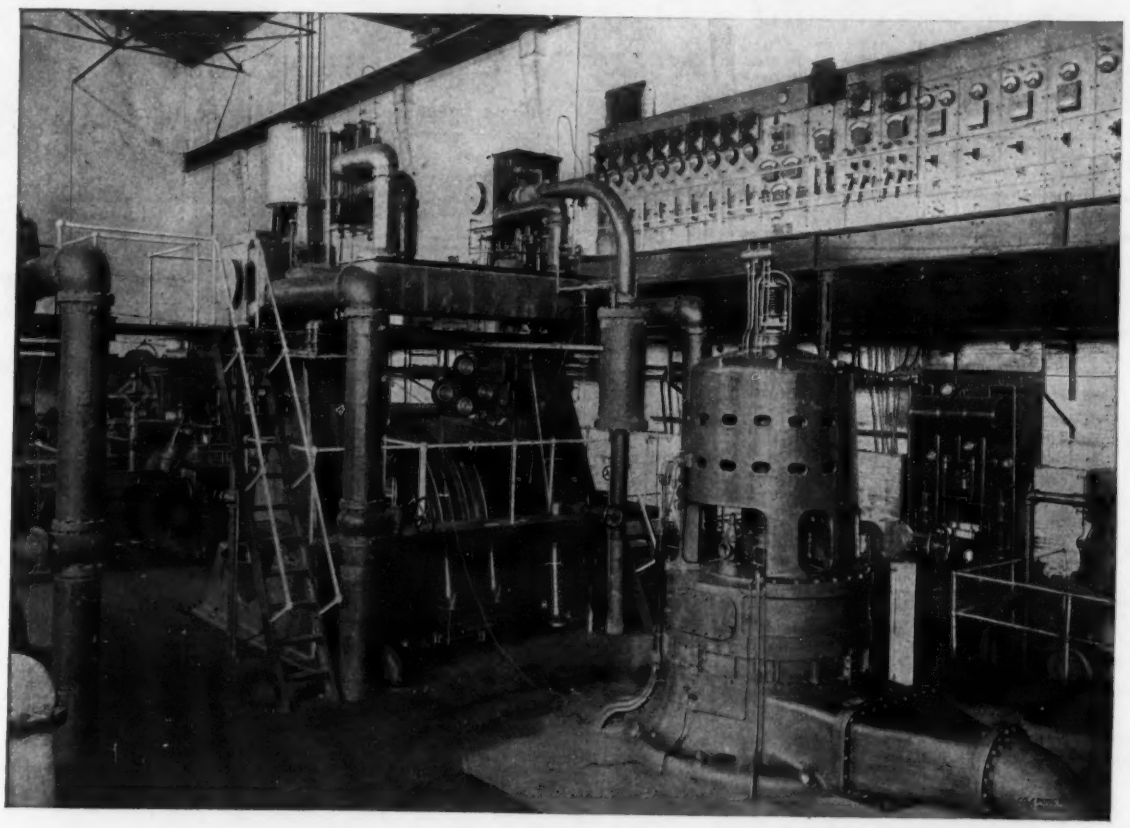

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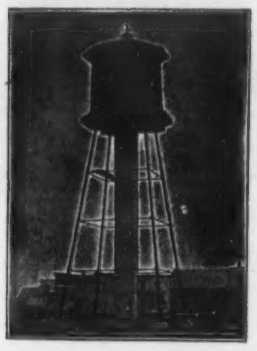

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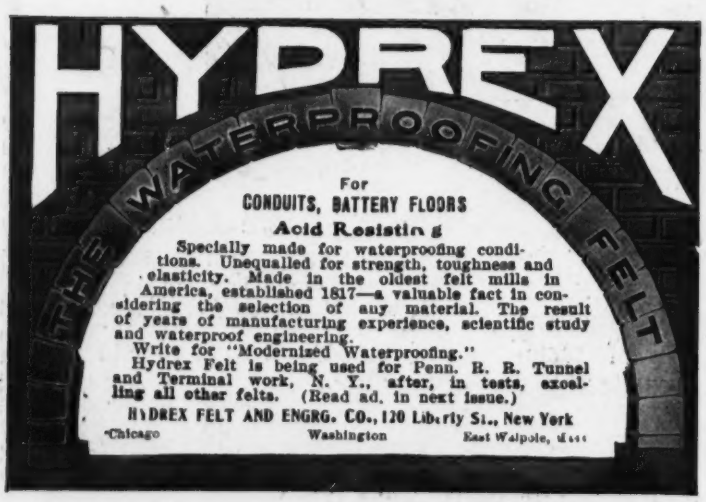

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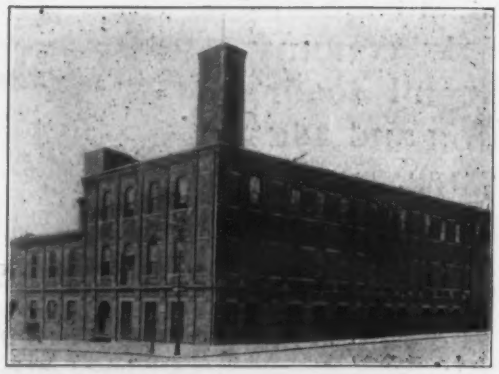

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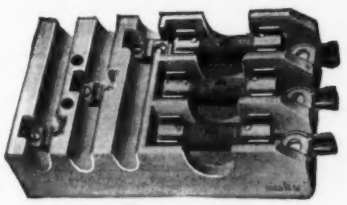

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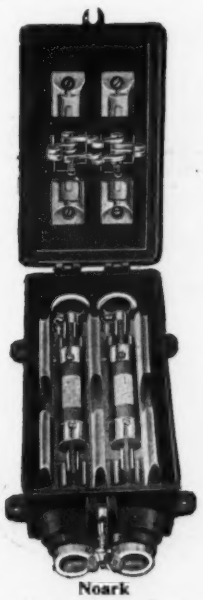

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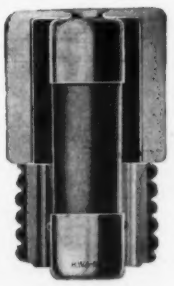

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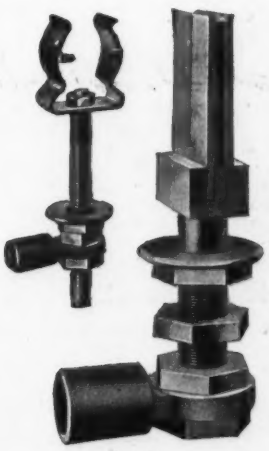

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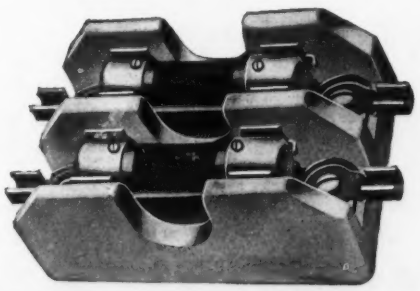

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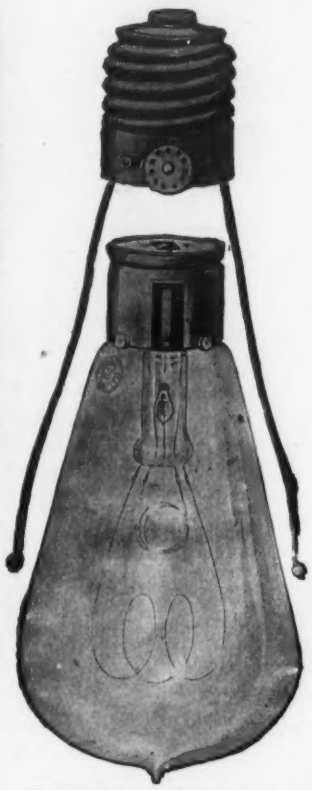

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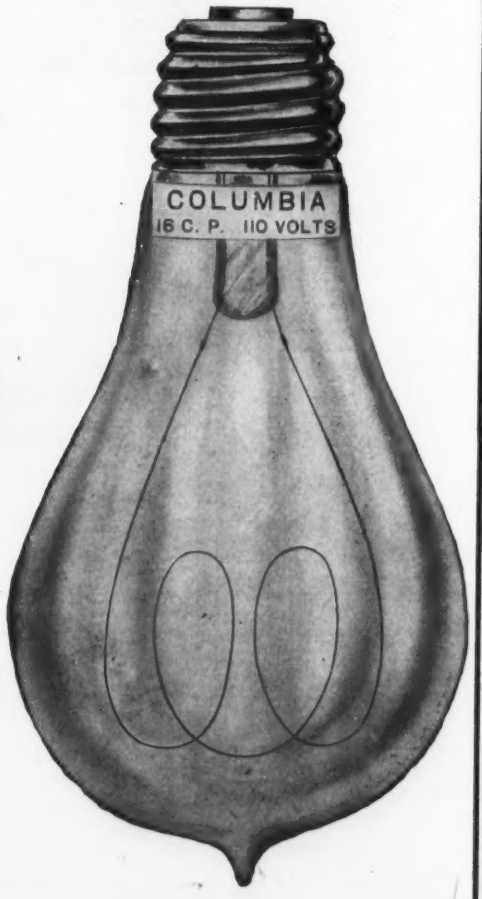

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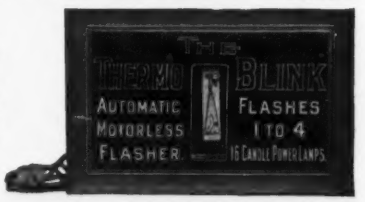
FREE

One of these flashing display signs complete, size, 12" x 18", given free to dealers, with their first trial order for 50 No. 1 Flashers at trade prices.



Sign is of glass; letters, gold outline, in colors on black ground. Frame and back of metal, finished dull black.

Space in centre shows a Thermo-Blink in action, how it is connected and the whole story at a glance.

Sells flashers and is an ornament and attraction to any store. Add a good line to your business by writing to-day.

Advertising Mirrorgraph Co., Hudson Avenue and Concord Street. **Brooklyn, N.Y.**

CAMPBELL THERMO FLASHER

Made on a new principle, is heavily constructed, flashes regularly and will hold its adjustment.

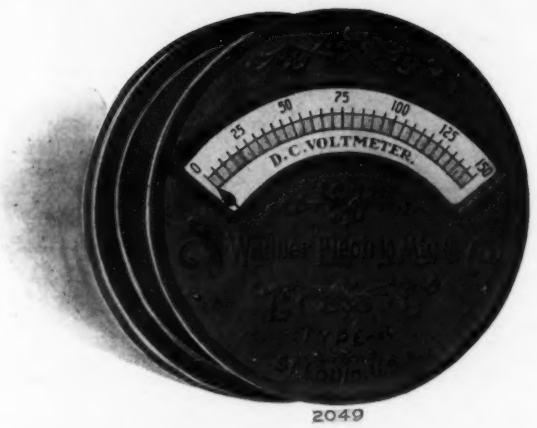
BEST OUT.

Send us **$1.00** and we will mail you one.

CAMPBELL ELECTRIC CO., Lynn, Mass., U. S. A.

WAGNER

Round Type
Indicating Meters



2049

These instruments are constructed on the D'Arsonval principle; the moving parts are light, yet of sufficient strength for the work they have to perform. These instruments have full jewelled bearings, and are absolutely dead beat, being electrically damped.

We commend these instruments to your attention and recommend them for use where a round pattern instrument is desired, as being the equal of or superior to any instrument of similar type on the market. They follow the general excellence in design and workmanship shown by all Wagner product.

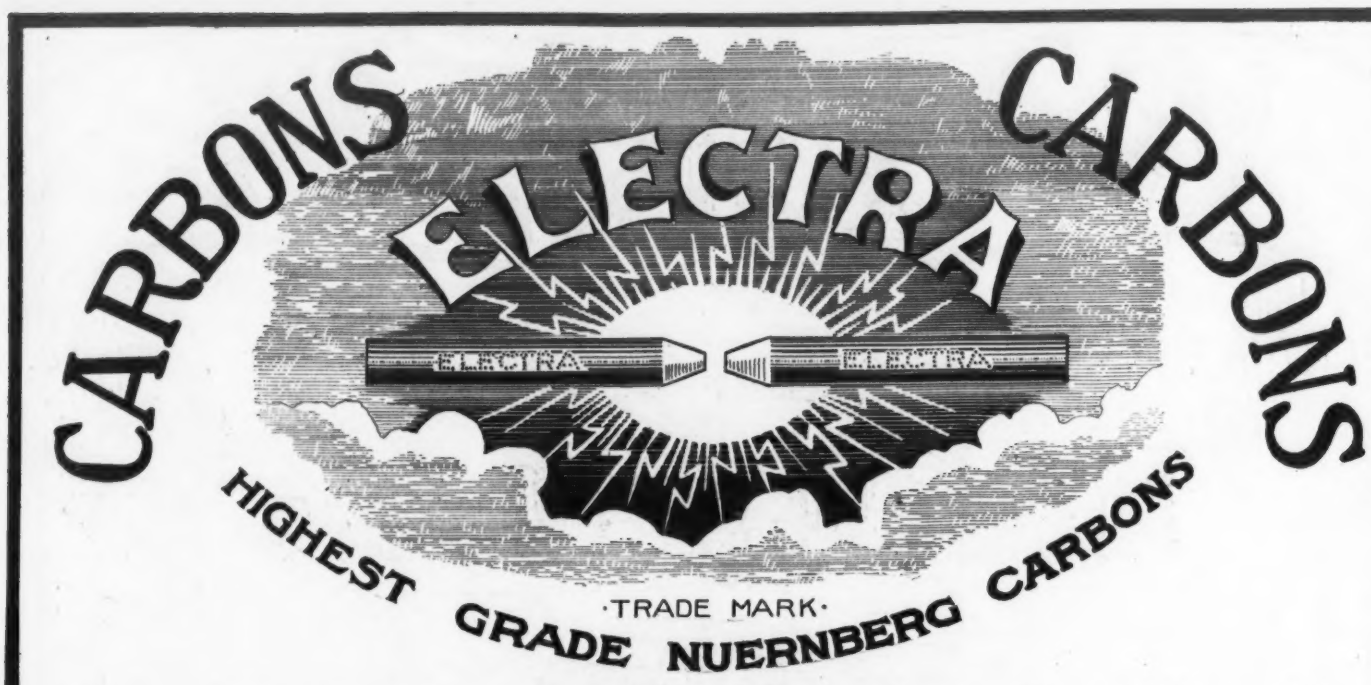
Following our general policy of meeting our customers with a broad gauged and liberal policy, we present herewith our "Guarantee" for your attention; note this is given on new lines and is unique in its liberality:

Bulletin No. 67-D

Main Office and Factory, St. Louis, Mo.

Offices in all the principal Cities in the United States

THE WAGNER ELECTRIC MFG. CO.
ST. LOUIS, U. S. A.



These carbons are the standard of the world.
They give more light, whiter light and less dust than any other carbon.
Their quality is uniform and always of the highest grade.
Diameter and straightness perfect.
Awarded "Grand Prize" St. Louis World's Fair, 1904.

HUGO REISINGER, SOLE IMPORTER
11 BROADWAY NEW YORK

FREEMAN'S
BRASS CAP ATTACHMENT PLUG.

No notches in cap to hold lining in. Smooth bushing for cord. Will bottom in Weather-proof Socket. Will take re-inforced cord. Porcelain extra strong. Prices Reasonable. Send for Sample and Prices.

E. H. FREEMAN ELECTRIC CO.
100 HAMILTON AVENUE. TRENTON, N. J.

CRESCENT
Fuseless Porcelain Attachment Plug

EXTRA heavy porcelain, hard to break, poles separated by a solid wall of porcelain, which, with other features, protects short circuits. Other specialties see booklet.

WE ALSO MAKE PANEL BOARDS

CRESCENT ELECTRICAL MFG. CO., Rochester, New York

Heany Fireproof Insulated Wire Patents Sustained

THE TETER-HEANY DEVELOPING COMPANY, of York, Penna., manufacturing the HEANY FIREPROOF INSULATED WIRE, informs its customers, and the public that on February 23, 1906, in the suit brought by Louis W. Downes of the D. & W. Fuse Co., Providence, R. I., against this Company, an opinion was handed down by his honor Judge Archibold, of the U. S. District Court, for the Middle District of Pennsylvania, in which it was held that this company does not infringe upon any of the Downes patents and that the suit must therefore be dismissed at cost of the plaintiff.

This is a signal victory for the HEANY FIREPROOF INSULATED WIRE, and vindicates it against the public charges made by Downes.

W. R. OSTRANDER & CO.

MANUFACTURERS OF
ELECTRIC BELLS,
ANNUNCIATORS,
SPEAKING TUBES, ETC.
ELECTRIC LIGHT SUPPLIES.
Factory, 1433-1439 DeKalb Ave., Brooklyn 22 DEY ST., NEW YORK

THE ELECTRICAL WORLD
TREATS OF BOTH THE ECONOMIC AND THE BUSINESS SIDE OF THE CENTRAL STATION

Anchors that hold

Clamps that hold

1906 CATALOG

SEND FOR OUR HANDSOME NEW CATALOG TELLS ALL ABOUT THE

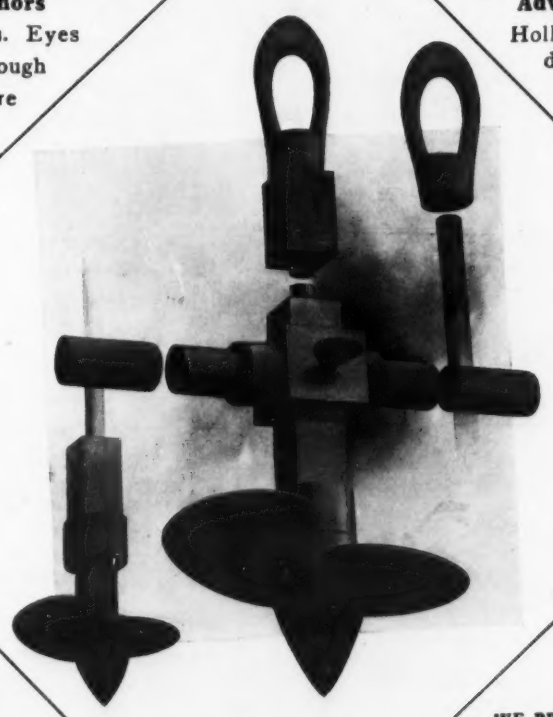
The Type B Stombaugh Guy Anchor

Advantages of Type B Anchors

Rods made in one piece. No welds. Eyes are removable and are large enough for half-inch guy thimbles. They are dropped forged. Shank of anchors are made square, and are much stronger. Shanks on 5 and 6-inch anchors are made the same size. Only one wrench is needed. These decided improvements have not increased the cost. The price of STOMBAUGH GUY ANCHORS remains unchanged.

SEND US A TRIAL ORDER FOR 12 OR MORE

W. N. Matthews & Bro.
227 N. 2nd St., St. Louis



IT IS FULL OF USEFUL INFORMATION KEARNEY CABLE CLAMP

The Type B Stombaugh Wrench

Advantages of Type B Wrench

Hollow shaft is made of seamless cold drawn steel tubing, reinforced at the bottom by a malleable iron square key. This change makes a much more durable and stronger wrench.

The handles are mounted in a sliding cross that can be moved up or down the shaft, giving the maximum leverage at all stages of the installation.

The removable eye of the anchor serves to lock the wrench so that it can't slip off while being bored in.

See Half-Tone for Detail of the Type B Improvements

WE PREPAY FREIGHT ON INITIAL 30 DAY TRIAL ORDERS

Manufacturers
33 Cortlandt St., New York

THE
EXCELLO ARC LAMP COMPANY
24 and 26 East 21st Street
NEW YORK

EXCELLO "Sunray" and "Snowball"
LUMINOUS ARC LAMPS

Current Consumption Guaranteed
.265 WATTS PER C. P.

Mechanism and durability fully warranted for one year. Write for Catalogue.

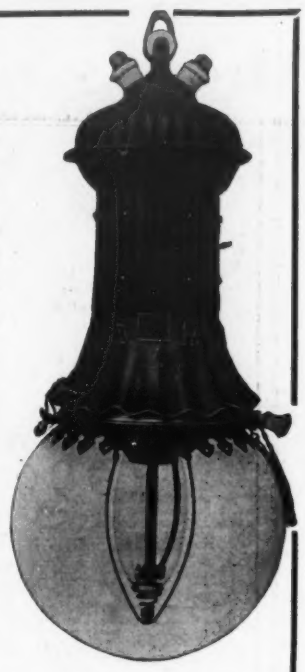
Here's what makes
A-B ARC LAMPS
the lamps chosen by those who examine carefully:—

Hard rolled stamped sheet copper, weather-proof case.

Door in case for access to inside mechanism.

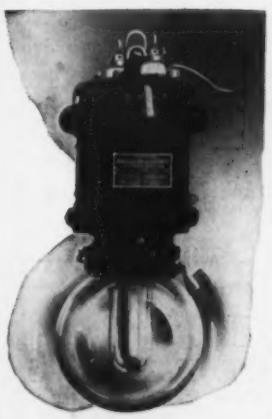
Porcelain insulations for hanger and binding posts.

Strong, heavy hand switch, carefully designed air pot. Cup-shaped inner globes, flexibly supported against ground seat, single negative rod for lower carbon holder support, ease of trimming, adaptability for hot trimming.



BULLETINS TELL MORE
The Adams-Bagnall Electric Co.
CLEVELAND
OHIO
New York Office 136 LIBERTY ST.
Chicago Office 303 DEARBORN ST.

DON'T KICK BUT specify
COLUMBIA CARBONS
on your NEXT order
They NEVER FAIL to give SATISFACTION
Send for our attractive trial proposition
NATIONAL CARBON COMPANY, CLEVELAND, OHIO

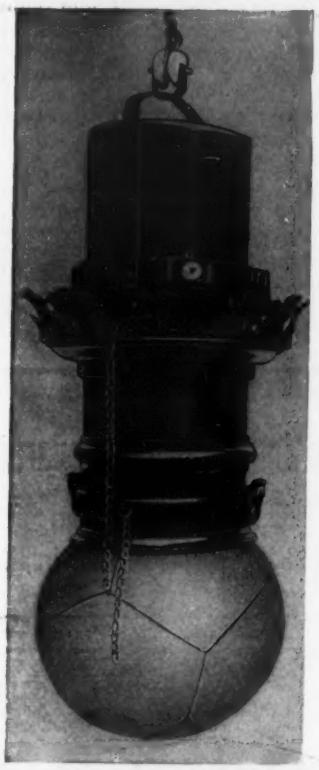


STANDARD
DIRECT CURRENT
FACTORY LAMPS
Made to withstand rough usage
IMPORTANT FEATURES
Indestructible Magnets
Accessible Parts
Simplicity of Construction
Low Cost
Manufactured by
American Arc Lamp Co.
KALAMAZOO, MICH.

Suspend Your Arc Lamps With
ONEIDA GALVANIZED CHAIN
The most perfect attachment for raising and lowering arc lamps made.
Heavily Galvanized—Rust Proof
IT WILL OUTWEAR CORD, CABLE OR ROPE
Manufactured by
ONEIDA COMMUNITY, LTD. Oneida, New York

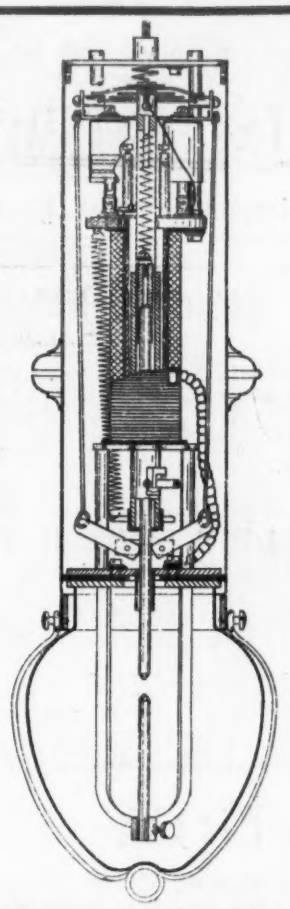
BENJAMIN WIRELESS CLUSTERS AND LIGHTING SPECIALTIES
Write for Catalogue
BENJAMIN ELECTRICAL MFG. COMPANY
CHICAGO - NEW YORK

There's no successful competition against these!



SIEMENS "Liliput" Arc Lamps→
Cover the field between incandescent lamps and ordinary arc lamps. Their dimensions are:—Cylinder cover, 2½ inches in diameter and 12.3 inches long. Globe diameter, 3.25 inches. Direct current type for 2 or 3 amperes at 80 volts, giving 260 and 560 C.P. respectively with alabaster globe. There is nothing to take their place for indoor or outdoor use.

←—Siemens Flaming **ARCS**
are without a peer for outdoor illumination. Two of them in series give 8,000 to 10,000 C.P. on a 110 volt circuit with but 11 to 12 amperes; giving a golden yellow, red or brilliant white light. Simple, durable and extremely reliable. Write for details.

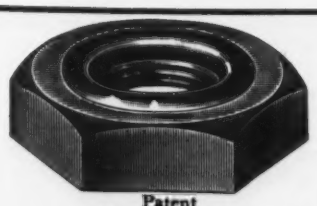


Felix Hamburger, 90 William Street, New York

Diehl
TRADE MARK

FANS, MOTORS, GENERATORS
FOR ALL ELECTRICAL PURPOSES
Makers of the Reliable
DIEHL APPARATUS
DIEHL MFG. CO.
Elizabethport, N. J.
Branches:
Boston, New York
Philadelphia, Chicago

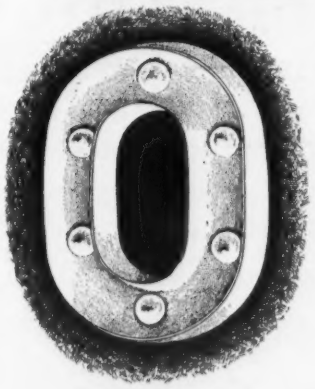
Emerson Fans
For Alternating Current
New 1906 Desk and Ceiling Styles
Latest Catalogue Now Ready.
The Emerson Electric Mfg. Co.
St. Louis, Mo.
Eastern Office and Warehouse, 136 Liberty Street, New York City
Small Alternating and Direct Current Power Motors.



Patent Applied For.

THERE ARE BUSHINGS AND APPLETON BUSHINGS
Bushings, as a rule, are made principally to sell. Appleton Bushings are made to give the best service. The selling follows as a consequence. They can't mar the wire and every thread is perfect. Samples on request.
APPLETON ELECTRIC COMPANY
224-226 E. WASHINGTON STREET, CHICAGO
227 FULTON STREET, NEW YORK

THE BEST YET!
Porcelain Electric Letters
FOR DAY AND NIGHT SIGNS



Save 50% in Lighting Bills.
Will Not Rust.
Are Water-Proof.
Cannot Short Circuit.
No Paint to Blister.

Patented April 22, 1902.

Address:
Colonial Sign & Insulator Co.
SOUTH AKRON - OHIO

Represented by
E. B. SATHAM & CO., New York
AMERICAN ELECTRIC SIGN CO., Boston, Mass.
PITTSBURG ELECTRIC SPEC. CO., Pittsburg
W. N. MATHEWS & BRO., St. Louis
S. J. CONGER, San Francisco

THE TRADE MARK OF SUPERIORITY
Look for the Blue Glass on the Stem
An Assurance for the Reliable
Jaeger Miniature Lamps
Made of every known description. For every known purpose.
Jaeger Miniature Lamp Mfg. Co. BIBLE HOUSE, NEW YORK CITY

Automatic Motor-Controlling Devices
Elevator Controllers Self Starters
J. L. SCHUREMAN CO.
70-86 West Jackson Boul., CHICAGO
European Agents, Geipel & Lange, LONDON

BAY STATE RENEWED LAMPS

Some new lamps in every lot are defective. In making Bay State Renewed Lamps we throw away these defective ones and *refill* and exhaust just as new lamps are filled and exhausted, the perfect lamps only. So that, as a whole, any lot of Bay State Lamps (12c.) is much more certain to burn longer and to give better light than an equal number of new lamps (18c.).

TEST THE AVERAGE LAMP

BAY STATE LAMP CO.
DANVERS, MASS.
PHILADELPHIA 146 N. 7th St.
NEW YORK 136 Liberty St.

LOOK FOR THE LICENSE LABEL

VACUUM DRYING AND IMPREGNATING APPARATUS
Emil Passburg System
Electric Cables Armatures
Field Transformers Magnet Coils
Passburg Patents
JOSEPH P. DEVINE, 314 Mooney-Brisbane Building Buffalo, N. Y.
OVER 700 APPARATUSES IN USE

Vacuum Drying and Impregnating Apparatus
FOR ARMATURES, ELECTRIC CABLES, MAGNET COILS, FIELD TRANSFORMERS
Norman Hubbard's Sons, 265-267 Water St., Brooklyn, N. Y.

NOW IS THE TIME
when the *Simplex Electric Chafing Dish* is extremely popular for serving tempting delicacies. After serving, the upper part may be removed and the electric heater used for percolating the coffee.
Safer, cleaner and less expensive than with alcohol or other methods. It connects to any incandescent lamp socket and operates quickly by turning the switch.

"SIMPLEX QUALITY."

Sizes and styles to suit requirements. Sold direct or through dealers.
Send for Illustrated Catalog and Price List G, "Electric Heating."

SIMPLEX ELECTRIC HEATING COMPANY,
Chicago Office, Monadnock Block.
CAMBRIDGEPORT, MASS.

No. 1205—List Price, $16.00.

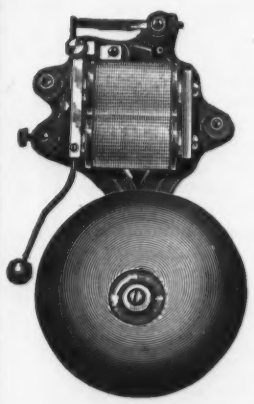
Arc Lamp Poles

IRON ARC LAMP POLES
ELECTROLIERS
GAS LAMP POSTS
BRACKETS

Catalogues and price lists on application.
The J. L. Mott Iron Works
84-90 Beekman Street
NEW YORK

DRILLS - REAMERS, ETC.

Trade Mark
The CLEVELAND TWIST DRILL CO.
New York Store: 62 READE ST.
Factory and Office: Cleveland, O., U. S. A.
Chicago Store: 17 SO. CANAL ST.



Buy BELLS Now
PIVOTED ARMATURE
CAST BELL METAL GONGS. PURE PLATINUM CONTACTS.

"F" Bell	2½-in.	each	$0.61
" "	3-in.	"	.65
" "	4-in.	"	.71
" "	5-in.	"	1.04
" "	6-in.	"	1.17
" "	7-in.	"	1.67
" "	8-in.	"	1.83
" "	10-in.	"	2.92

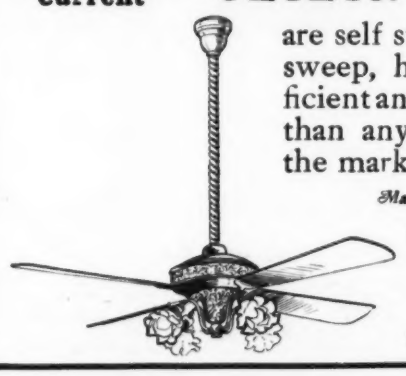
We have a big line of bells of every description.
Manhattan Electrical Supply Co.,
NEW YORK. CHICAGO.

A WATER-WHEEL GOVERNOR

So simple your own men can install and operate it successfully. Quick control of large changes. Accurate control of small changes. Ask for our new catalogue.

WOODWARD GOVERNOR CO.
ROCKFORD, ILL.

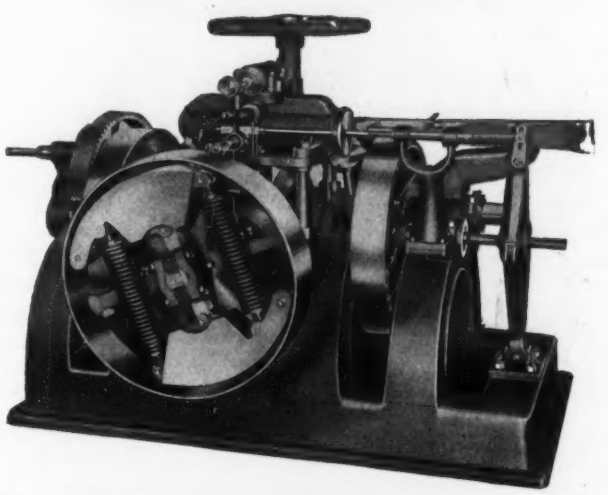
"PILLSBURY"
Alternating Current CEILING FANS



are self starting, 58 inch sweep, high speed, efficient and have less parts than any other fan on the market.

Manufactured by
Century Electric Company
404 N. 4th St.
ST. LOUIS, - MO.

The Improved Governor



Why not try a water wheel governor that will do more than adorn your power plant? A governor that can always be relied upon. The Improved Governors are ever alert. Ever watchful sentinels that will guard your interest in the plant.

Holyoke Machine Company
Worcester, Mass.

The "Standard" Fans

The Famous Style "B"

This Ceiling Fan, now in its tenth season, is growing more popular every year. It has been made practically without change since its introduction.

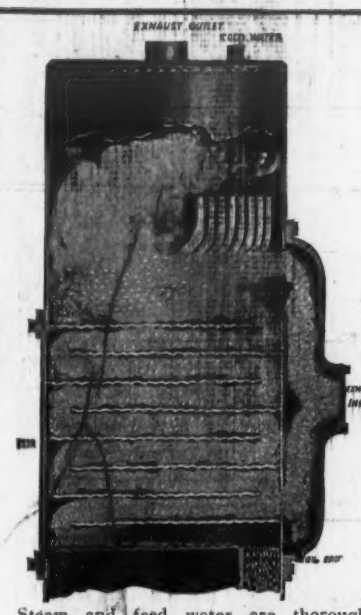
It is very powerful, and will last a lifetime. It is the lowest in price of our several Ceiling Fan models.

The Style "B" is finished in plain black, japan or oxidized copper.

This Fan when finished in plain black is sold at a lower price than has ever before been made on a good Ceiling Fan.

The Robbins & Myers Co.,
MAIN OFFICE AND WORKS, SPRINGFIELD, OHIO

NEW YORK, 66 Cortlandt St.
BALTIMORE, Room 513 Baltimore American Bldg.
ST. LOUIS, 12 North Eighth St.
PHILADELPHIA, 730 Witherspoon Bldg.
BOSTON, 235-237 Congress St.
LOS ANGELES, 278 South Main St.
SAN FRANCISCO, 523-525-525½ Mission St.



Steam and feed water are thoroughly mixed, heating water and causing precipitation of impurities.

The Great Corporations

owe their prosperity in most cases to the many very profitable small savings which they have systematically introduced in the industries controlled by them. For instance, in every steam plant not equipped with a

STILWELL FEED-WATER HEATER

there is an opportunity to save from 10 to 15% of the coal bill. Such a saving is often decisive in close competition. It means a return of more than 100% upon the investment. Indeed, Meyer states in his "Steam Power Plant" that "The heater will in many locations reduce the fuel consumption enough to pay for itself in a few months, the exact time depending upon the cost of the fuel."

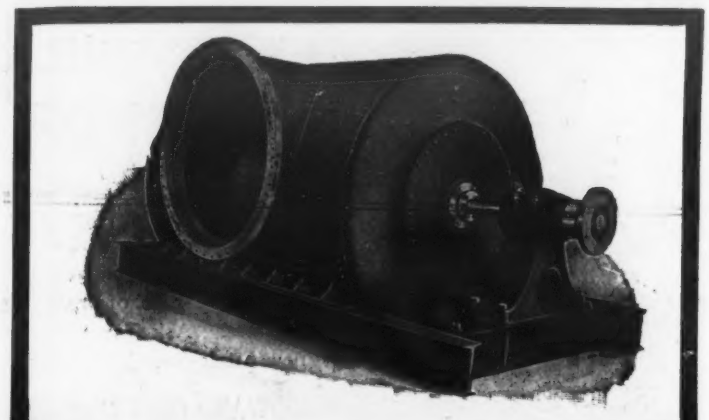
In addition it saves boiler repairs and boiler cleaning bills and absolutely stops all oil. Send for our BOOK "EW" on Boiler Feeding.

The Platt Iron Works Company

Successors to the Stilwell-Bierce & Smith-Vaile Co.

DAYTON, OHIO, and All Large Cities

Builders of Pumping Machinery, Water Wheels, Air Compressors and Power Plant Apparatus.



This Installation

of water wheels should interest engineers. The plant is at Sao Paulo, Brazil, where a pair of 22-inch.

"New American" Turbines

is developing 1,000 H. P., running 450 R. P. M. under 75 feet head, direct-connected to generator.

Note the design of flume and bearings and general appearance. Write for Catalogue No. 12.

For durability, great capacity and economy of water, the "New American" turbines are unexcelled, while their speed has never been equalled by other turbines.

THE DAYTON GLOBE IRON WORKS COMPANY

DAYTON, OHIO, U. S. A.

Pacific Coast Agents:

Pelton Water Wheel Co. San Francisco, Cal.

Water Wheel Facts

The PELTON was the first impulse water wheel.

We have been perfecting this wheel for 19 YEARS and offer a water wheel of exceptional merit.

We request the opportunity of corresponding with those interested in WATER POWER and can present interesting facts, particularly in connection with HYDRO-ELECTRIC and MINING POWER.

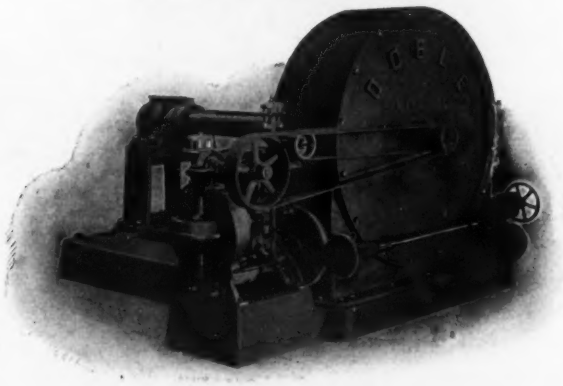
Illustrated Catalog on application.

THE PELTON WATER WHEEL COMPANY

30 MAIN ST., SAN FRANCISCO 141 LIBERTY ST., NEW YORK

Agents The Sturgess Water Wheel Governor

DOBLE WATER WHEELS



Have been built for Heads from 20 to 2200 feet and up to 9000 horsepower capacity, these being single units taking water from SINGLE DOBLE JETS.

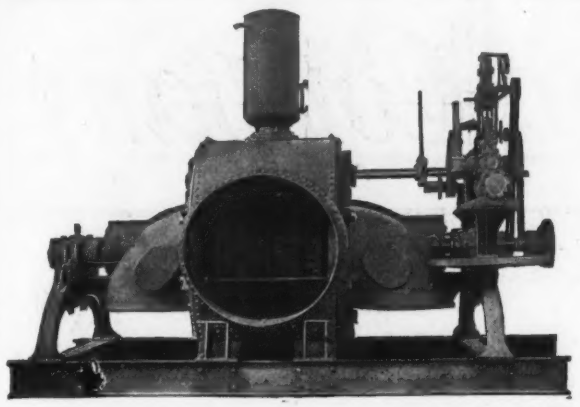
Write for our new 100-page Bulletin No. 7.

Abner Doble Company

Established 1850 ENGINEERS

SAN FRANCISCO, CAL., U. S. A.

Exclusive Licensee in Canada:
The John McDougall Caledonian Iron Works Co., Ltd., Montreal.



SAMSON TURBINE

The QUICKER the SPEED of a GENERATOR, the LOWER its COST.

The SAMSON has a quicker speed for a given power than any other turbine built. If you expect to DIRECT CONNECT generator to turbine shaft, we can certainly SAVE you considerable EXPENSE in your installation.

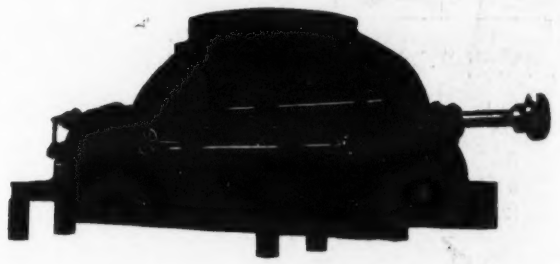
JAMES LEFFEL & CO.,

308 Lagonda St., Springfield, Ohio, U.S.A.

PAIR

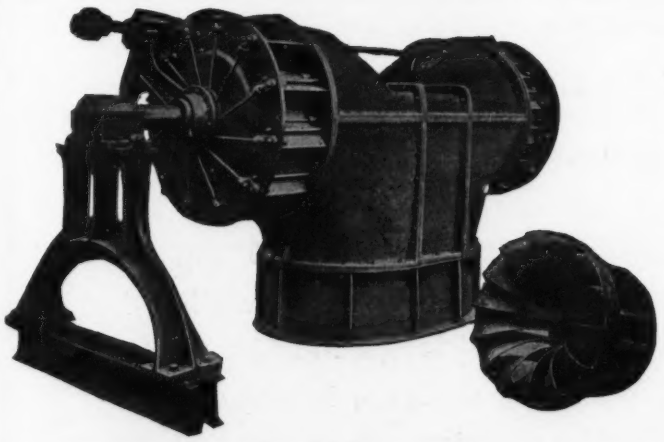
McCORMICK TURBINES

4,000-H.P., 80-ft. head, arranged to drive generator and a single turbine to drive exciter. Seven settings built for the Hudson River Water Power Company for their Spier Falls plant and 14 pairs 51-in. for their plant at Mechanicsville, N. Y. *Write for catalogue, if contemplating purchase of turbines.*



S. MORGAN SMITH CO., York, Pa., U.S.A.

BOSTON OFFICE
176 Federal Street



RISDON-ALCOTT TURBINE CO.

MOUNT HOLLY, NEW JERSEY, U. S. A.

Manufacture the....

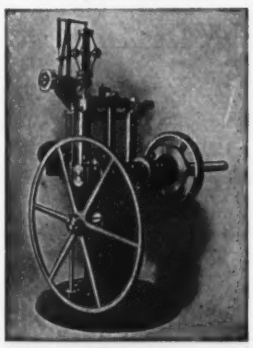
LEVIATHAN
Hinged Gate Turbine

FOR SPEED, POWER AND EFFICIENCY IT EQUALS ANY WHEEL MADE

Upright and Horizontal

These Turbines are recognized as the most effective Water Wheels made
Your inquiries should come direct to us for this class of machinery

WATER WHEEL GOVERNORS



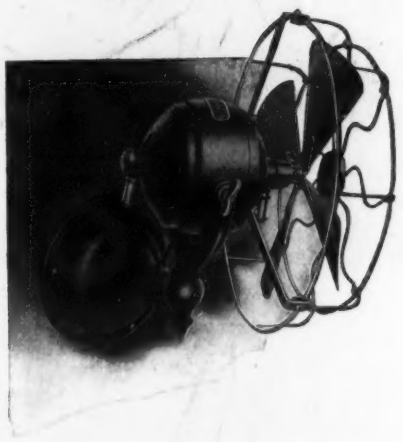
Type N Governor

We make them.
They govern.
We guarantee them, and "stand pat."
Write for printed matter.

THE LOMBARD GOVERNOR CO.
ASHLAND, MASS.

General Electric Company

Fan Motors 1906



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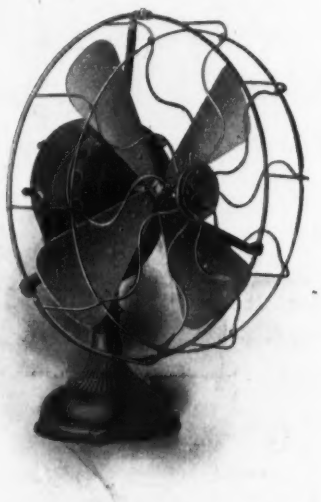

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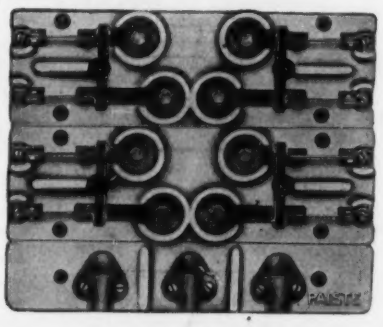

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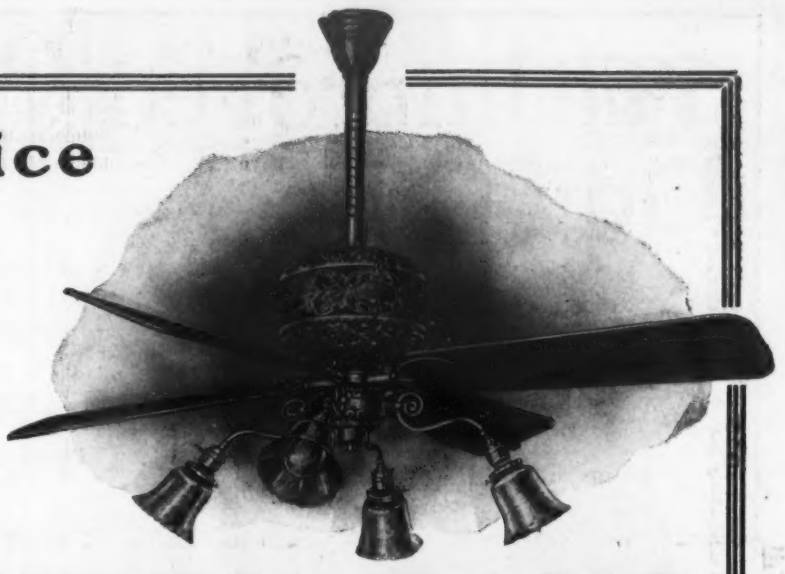

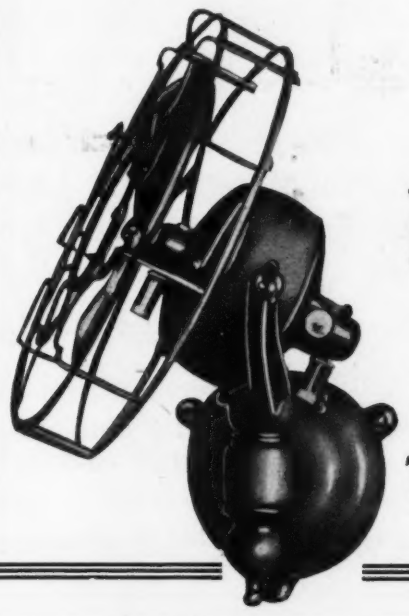

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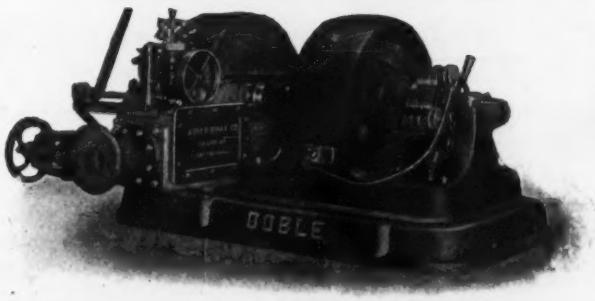

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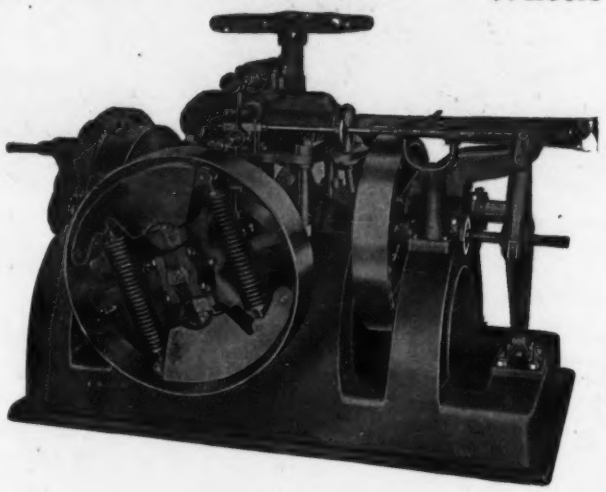

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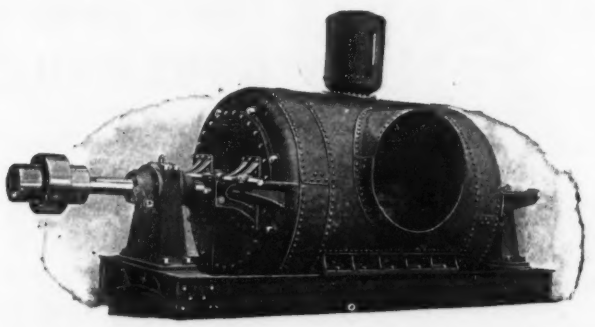

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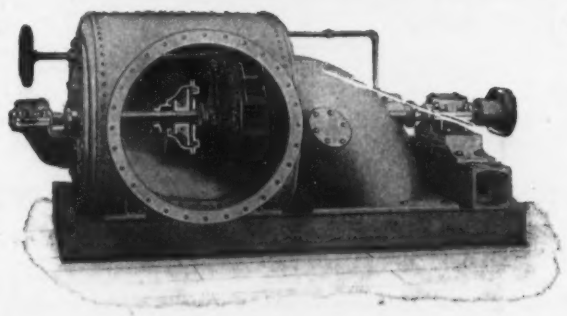

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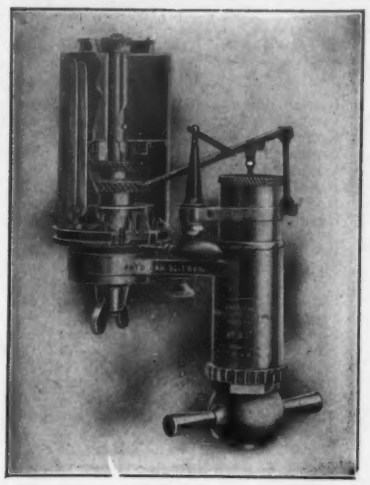

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Yearsley & Levene.

SEPARATORS, OIL & STEAM.
Harrison Safety Boiler Works.

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Solar Electric Co.

SHADES, METAL.
D'Olier Co., Jr., H.
Federal Electric Co.

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Electric Motor & Equipment Co.
Haller Machine Co.
Metropolitan Eng'g Co.
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Haller Machine Co.
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SLEEVING, BRAIDED.
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SOCKET KEYS.
Dickinson Mfg. Co.

SOCKETS.
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Crescent Elec. Mfg. Co.
Federal Electric Co.
Freeman Elec. Co., E. H.
General Electric Co.
General Mfg. & Supply Co.
Hubbell Harvey.
Paiste Co., H. T.
Peru Elec. Mfg. Co.

SOLDER.
Belden Mfg. Co.

SOLDERING FLUX.
Allen Co., L. B.

SOLDERING IRONS.
Brown & Co., L. P.
Simplex Electric Heating Co.

SOLENOIDS.
Cutler-Hammer Mfg. Co.
Schuren n, J. L. Co.

SPEED INDICATORS.
Schaeffer & Budenberg.

SPRINGS.
Barnes Co., Wallace.
Cary Spring Works.

STAPLES. (See Insulating Material, Staples.)

STEAM TRAPS.
Sturtevant Co., B. F.

STEEL.
American Bridge Co.
Hungerford Brass & Copper Co.
Leslie & Co., A. C.

SUPPLIES, ELECTRICAL RAILWAY.
Anderson Mfg. Co., A. & J. M.
General Electric Co.
Johns-Manville Co., H. W.
Sarco Company.
Standard Electrical Works.
Westinghouse Elec. & Mfg. Co.

SUPPLIES, GENERAL ELECTRICAL.
Bissell Co., F.
Central Electric Co.
Electric Appliance Co.
Electrical Equip. & Supply Co.
General Electric Co.
General Mfg. & Supply Co.
Manhattan Elec'l Supply Co.
Ostrander & Co., W. R.
Sarco Company.
Standard Electrical Works.
Stuart-Howland Co.
Western Elec. Co.
Westinghouse Elec. & Mfg. Co.

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Kellogg Switchboard & Supply Co.
Western Electric Co.

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Amer. Elec. Telephone Co.
Anderson Mfg. Co., A. & J. M.
Bissell Co., F.
Bossert Elec. Constr. Co.
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Electric Equipment & Supply Co.
Kellogg Switchboard & Supply Co.
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Dickinson Mfg. Co.

SWITCHES, CEILING.
Krantz Mfg. Co., H.

SWITCHES, CLOCK.
Bissell Co., F.
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Hartman Circuit Breaker Co.

SWITCHES, SNAP.
Bissell Co., F.
General Electric Co.
Hart Mfg. Co.
Sarco Company.
Trumbull Elec. Mfg. Co.

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American Elec. & Novelty Co.
Sarco Company.

TABLET BOARDS.
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Crescent Elec'l Mfg. Co.
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American Electric Telephone Co.
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New York Telephone Co.

TELPHERAGE.
Dodge Coal Storage Co.
United Telpherage Department.

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Central Laboratory Supply Co.

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Electrical Testing Laboratories.

TESTING LABORATORIES.
Electrical Testing Laboratories.

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Holyoke Mch. Co.
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JULY 6
For the July Export Issue

ELECTRICAL WORLD
114 Liberty St., New York

POSITION WANTED

The rate for "Position Wanted" advertisements of forty words or less is one dollar an insertion; additional words two cents each, payable in advance. Remittance and copy should reach this office not later than Monday, 5.30 P. M., for the next succeeding issue.

WORK WANTED.—Young man, single, technical education, fourteen years' broad general experence in design, specifications, economy in manufacture, appraisals, examinations and reports. Some years assisting a prominent consulting engineer of New York. Open for engagement, temporary or permanent, whole or part of time. Address Reasonable, care Electrical World, New York.

POSITION WANTED.—By a construction man of 10 years' experience, as superintendent of lighting plant in town of about 10,000; accustomed to handling men, and experienced in both alternating and direct current work; good references. Address No. 2746, care Electrical World, New York.

POSITION WANTED.—Man with general shop experience, good electrical education, understanding the use of the steam indicator and the methods of testing and installing motors, meters, etc., desires a position with eastern concern as assistant engineer. Box 397, Chicago, Ill.

POSITION WANTED.—Young, energetic American desires connection with privilege of investing. Chemical, electric manufacturing and construction experience. Member Engineering Society. Strictly temperate. Define proposal. Mutual rigid investigation desired. Immediate returns not important. Address No. 2783, care Electrical World, New York.

POSITION WANTED.—By young man, 20 years old, with technical education. Has experience in construction and central station work. Is seeking any electrical or mechanical job where he will do most good and earn most money. Good references. Address No. 2769, care Electrical World, New York.

POSITION WANTED.—Electrical construction man wishes to engage with lighting, power or engineering company, with the view of taking charge and developing construction or maintenance department; 10 years' experience in lighting and power work, D. C. and A. C. estimating and superintendence; at present engaged in consulting and supervising work; technical; A1 references; salary a secondary consideration at present. Address 2782, care Electrical World, New York.

POSITION WANTED.—Competent, practical electrician, now holding position as assistant to chief electrical engineer of large light and power company; 15 years' experience installing and operating lights, power plants; thoroughly familiar with high and low tension apparatus, A.C and D.C., 2-3 phase, overhead and underground construction; able to handle men and make all repairs on generators, motors, transformers and instruments; willing to go anywhere. Address No. 2775, care Electrical World, New York.

POSITION WANTED.—By electrical engineer, 8 years' practical experience with first-class consulting engineering concerns; specialty, layout, erection, estimating all size light, power and railway plants, A.C and D.C.; thoroughly familiar with all A.C. problems; position with consulting electrical engineering concern New York vicinity preferred. Address No. 2777, care Electrical World, New York.

POSITION WANTED.—As assistant to consulting or contracting engineer, by practical electrical and mechanical engineer; college graduate; 6 years' experience on heating and ventilating, electrical generators and motors, design, testing and erection, estimating on power stations and transmission lines; at present employed as superintendent; highest references. Address No. 2778, care Electrical World, New York.

POSITION WANTED.—By electrical engineer, college graduate, with extensive experience in the electrical engineering line, D. C. motors and generators a specialty; desire position as engineer with manufacturing concern. Address No. 2779, care Electrical World, New York.

POSITION WANTED.—By young man, graduate of technical school; practical experience in all classes inside wiring, pole and line construction, transformers, motors, electric railway work, underground conduit, estimating, soliciting, drafting and office work; references and bond; can go anywhere. Address No. 2780, care Electrical World, New York.

POSITION WANTED.—As manager of a lighting and power plant; practical man, mechanical and electrical; can increase the plant's earnings and decrease cost of repairs and operating expenses; 32 years of age and single. Address No. 2781, care Electrical World, New York.

POSITION WANTED.—By young man, at present employed, estimating and superintending construction work; have had 12 years' practical experience, and am competent to handle complete installations; have good executive ability, and can furnish first-class references. Address No. 2770, care Electrical World, New York.

POSITION WANTED.—By electrical engineer (Columbia, '99), experienced in motor and dynamo testing, interior telephone, lighting, etc. For the first two years associated with large electrolytic refinery as assistant superintendent electrolytic department. Age 27; single; knowledge of German; references. Address No. 2784, care Electrical World, New York.

HELP WANTED

The rate for Help Wanted advertisements of forty words or less is one dollar and fifty cents an insertion; additional words three cents each, payable in advance. Remittances and copy should reach this office not later than Monday, 5.30 P. M., for the next succeeding issue.

WANTED. — Salesmen or agents outside of New England to sell a renewed incandescent lamp on a commission basis. Address No. 2453, care Electrical World, New York.

WANTED.—INVENTORS.—Better your position by inventing. Difficult, but 100,000 have done it. Total cost to secure ordinary electrical patent, $75; 10 per cent less if simple non-technical device. Correspondence system, twenty years old. Highest references. Edward P. Thompson, M. E., Registered Patent Solicitor, 156 Fifth Ave., New York.

WANTED.—Salesman for motors and electric machinery to be sold to central stations. Man must be able to produce new business and thoroughly understand this line technically so that he may intelligently demonstrate the superiority of his goods over those of other manufacturers. Salary $1,200-$2,400. Write us to-day. HAPGOODS, 305 Broadway, N. Y.

WANTED.—DRAFTSMEN.—We want capable draftsmen of either electrical, mechanical or general experience. If you would like to change your position or its location, write and tell us about the character and extent of your work. Address, giving full particulars, to WESTERN ELECTRIC COMPANY, Dept. No. 29, Chicago.

WANTED.—Mechanical draftsman, $5.04 per diem. Structural steelwork draftsman, $5.04 per diem. A competitive examination will be held for the above positions July 6, 1906. For further information address "Commandant, Navy Yard, Brooklyn, N. Y."

WANTED.—A superintendent to take charge of the operation and repair work on an overhead and underground system of high and low tension lines. Near New York City. State age, experience and salary expected. Address No. 2771, care Electrical World, New York.

(Continued on page 72.)

Removed to Its Own Buildings. General Offices, Warehouses and Works,

now equipped for handling ANY SIZE electrical or steam apparatus and testing same. "Nothing like it in this country." We have a model shop equipped with railroad track in the building, electric traveling cranes,-- all tools electrically driven -- ample power and heating plant and modern conveniences throughout. Our Works are one of the "sights of Chicago," and visitors are cordially welcomed.

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ALTERNATORS—60 CYCLES

Lights.
2 900 Westinghouse, 45 K.W., single phase.
2 1200 Westinghouse, 60 K.W., two-phase, 1100 volts.
1 1200 Warren, 60 K.W.
1 1500 General Electric, 75 K.W., three-phase, 2200 volts.
1 1500 General Electric 75 K.W., three-phase, 3300 volts.
1 1500 Warren, 75 K.W., two-phase, 1100 or 2200 volts.
2 1500 Westinghouse, 75 K.W., two-phase, 1100 or 2200 v.
1 2500 Gen'l Electric, 125 K.W., three-phase type, A T B, revolving field.
1 5000 Westinghouse, 250 K.W., three-ph., revolving field, 6000 volts.

125 TO 133 CYCLES

Lights.
1 900 Westinghouse, 45 K.W.
1 1200 Wstgh., 60 K.W., 1100 v.
3 1800 Gen. Elec., A, 60, 1100 v.
1 2000 Wood, 100 K.W., type W. A. L.
1 2400 Westghse, 120 K.W., 1100 or 2200 v.
1 2400 General Elec., 120 K.W., type A S, 2200 volts.

H.P.
1 2400 General Elec., 120 K.W., type A, 120.
1 3000 Stanley, inductor type, 150 K.W., two-phase.

250 VOLT GENERATORS

K.W.
1 17½ Kester, comp.
1 17½ Eddy, type C, comp.
1 20 Western Electric, M.P.
2 35 K.W. Lundell, M.P.
1 33 K.W. Jenney, M.P.
1 25 Commercial d. c. to Westinghouse engine.
3 30 Westinghouse, M.P.
1 35 Western Electric, M.P.
1 45 Am. Engr. Co., M.P.
1 50 Maine, M.P., comp.
1 75 Siemens & Halske, Churchward type, M.P., brand new, for direct connection.
2 100 Crocker-Wheeler, M.P.
1 100 General Electric.
1 300 Western Electric, M.P., brand new, 8 pole, 3 bearing.

550 VOLT GENERATORS

K.W.
1 30 Wood, M.P.
1 75 Westinghouse, M.P.
1 100 Siemens & Halske, M.P.
1 200 Thompson Ryan, M.P.

ELECTRIC LOCOMOTIVES

Ton.
1 10 Morgan-Gardner, type M, 250 volt, direct current, double motor locomotive, 74 K.W., 42-inch gauge, speed 6 to 10 miles per hour.

ARC DYNAMOS

1 120-Light Brush No. 9½ 6.6 amp., 4 circuits with oil regulator.
2 80-Light Brush No. 9A 9.6 amp., with extra armature.
1 75-Light T-H M. D. 12.
1 50-Light T-H L. D. 12 self-oiler.
2 50 Western Electric 9.6 amp.

HIGH VOLTAGE TRANSMISSION APPARATUS

3 180 K.W. General Electric step up or step down transformer, type H, 10,000 or 17,300 to 588 volts.
3 200 K.W. General Electric step up or step down transformer, type H, 11,550 or 20,000 to 605 volts.
All oil switches, high tension, fuse blocks, etc., for above.

125 VOLT DYNAMOS

Lights.
1 50 Roth, M.P.
2 60 Hobart, M.P.
1 80 Western Electric, M.P.
1 80 Crocker-Wheeler.
1 80 Hobart, M.P., new.
2 100 Hobart. M.P., comp.
3 110 New England, M.P.
1 110 Akron, M.P.

GREGORY ELECTRIC CO.

COR. 16TH & LINCOLN STS.

Send for our Monthly Bargain Sheet showing NET prices—all machines fully guaranteed and actually in stock.

WANTED! FOR CASH

MOTORS – DYNAMOS.—Will pay SPOT CASH and buy any quantity large or small. With our facilities we can PAY MORE and still SELL CHEAPER – because we are willing to have a large turnover on small profits. Send your list of machines and get CASH. State make, type, speed, voltage, capacity We will make you a good offer by return mail.

Lights.
1 210 Eddy, M.P.
2 270 Eddy, M.P.
2 300 Westinghouse, M.P.
2 340 Western Elec., M.P.
1 400 Westgh., M.P., 22½ K.W.
1 450 Sprague-Lundell, M.P.
1 450 Quaker City, M.P.
1 450 Gen. Elec., M.P., comp.
1 450 West. Elec., M.P., Comp.
1 450 Gen. Elec. M.P., 25 K.W., direct connected to 8x10 Ideal self-oiling engine.
1 540 C. & C., M.P., 30 K.W.
1 540 Westghse., M.P., 30 K.W.
2 700 Commercial, M.P., comp.
1 700 Card, M.P., comp.
2 800 Gen. Elec., M.P., comp.
1 900 Wagner, M.P., comp.
1 1100 Triumph, M.P., comp.
1 1300 Card, M.P., comp., 72 K.W.
2 1300 W. Elec., M.P., 75 K.W.
2 1350 General Electric, M.P., 75 K.W., 6 pole, direct connected to Ames tandem comp., 11x17x12 automatic engine.
1 1450 General Electric, M.P., comp., form H, 85 K.W.
1 1800 Western Electric, M.P., comp., 6 pole, 100 K.W.
1 2500 Western Electric, M.P., 150 K.W., comp., direct connected to Ball & Wood compound engine.

110 VOLT MOTORS

H.P.
1 1 C. & C.
1 1 Diehl.
1 2 Jenney.
2 4 Hobart, multipolar.

DIRECT CONNECTED UNITS
(For Alternating Current)

300 K. W. G. E. 3 ph., 60 cy. 2,300 v. alternator and McIntosh & Seymour engine.
300 K. W. Westinghouse 2 ph. 60 cy, 2,300 v. alternator and cross comp. engine.
75 K. W. Westinghouse 2 ph., 60 cy., 1,100 v. alternator and Gates engine.

BELTED TYPE ALTERNATORS
(60 Cycles)

800 K. W. G. E. 3 ph., A. T. B., 2,300 v. alternator for direct connection; or water wheel drive.
360 K. W. G. E. 3 ph., 2,300 v.
250 K. W. G. E. 3 ph., A. T. B., 10,000 v. with step down transformers to 2,200 volts.
240 K. W. Stanley 2 ph., 1,100-2,200 v.
200 K. W. Bullock (2) single ph., 110 volts.
180 K. W. Stanley (2) 3 ph., 1,100-2,200 v.
180 K. W. Stanley (3) 2 ph., 1,100-2,200 v.
180 K. W. G. E. type A. S. 2,300 v.
150 K. W. G. E. (2) monocyclic 1,100-2,200 v.
135 K. W. Stanley (2) 2 ph., 1,100-2,200 v.
100 K. W. G. E. 3 ph., 2,300 v.
100 K. W. G. E. monocyclic 2,200 v.
75 K. W. Westinghouse 2 ph., 2,200 v.
60 K. W. Westinghouse single ph., 1,100-2,200 v.
45 K. W. Westinghouse single ph., 2,200 v.

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24 & 36 x 48 Allis cross compound.
20 & 36 x 48 Harris Corliss tandem.
18 & 34 x 48 Cooper cross compound.
18 & 30 x 16 Westinghouse compound.
17 & 28 x 18 (2) Harrisburg tandem.
16 & 27 x 16 Westinghouse compound.
26 x 48 Allis Reynolds Corliss.
22 x 48 Allis Reynolds Corliss.
18½ x 18 (2) A. L. Ide.
20 x 20 (2) Harrisburg.
18 x 20 Erie Ball.
17 x 24 Russell 4 valve.
14 x 36 Murray Corliss.
14 x 14 Harrisburg Ideal.
13 x 21 (2) Buckeye heavy duty.
10 x 12 Erie Ball.

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FOR SALE

110 VOLT MOTORS (Cont.)

H.P.		
1	5	Hobart, M.P.
1	5	Crocker-Wheeler, M.P.
1	5	Western Elec., M.P.
2	7½	New England, M.P.
2	7½	Hobart, M.P.
1	7½	Browning, M.P.
1	9	Bernard.
1	10	Edison, self-oiler.
1	15	Eddy, M.P., type G.
1	20	Jenney, self-oiler.
2	20	Westinghouse, M.P.
3	25	Western Electric, M.P.
2	30	Commercial, M.P.
1	30	Quaker City, M.P.
1	30	General Electric, M.P.
1	30	Westinghouse, M.P.
1	30	Western Electric, M.P.
1	33	Sprague-Lundell, M.P.
1	33	Eddy, M. P.
1	35	C. & C., M.P.
3	40	Card, M.P.
2	50	Commercial, M.P.
1	50	Card, M.P.
2	60	Gen. Elec., M.P.
1	65	Wagner, M.P.
1	80	Triumph, M.P.

220 VOLT MOTORS

H.P.		
1	1	Peerless, enclosed.
2	1	New England.
35	1	Gen. Elec., C. A.
1	1½	Sprague-Lundell.
1	2	Roth, M.P.
1	2	Bernard, M.P.
1	2	Watson.
1	2	Peerless.
2	2	Paragon.
1	2½	Browning.
1	3	Crocker-Wheeler.
3	4	Lundell.
1	5	Belknap, M.P.
2	5	Crocker-Wheeler printing press motors.
1	5	Western Elec., M.P.
1	7½	Eddy, type C.
1	7½	Western Electric, M.P., variable speed, double com't elevator motor.
1	8	Holtzer-Cabot.

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COR. 16th AND LINCOLN STS.

Send for our Monthly Bargain Sheet, showing NET PRICES

H.P.		
1	8	Western Electric, M.P., direct connected to Eaton & Prince elevator.
1	10	Eddy, type C.
1	10	Keystone, M.P., encld.
1	10	Westinghouse, M.P.
1	10	Bernard, M.P.
1	20	Sprague, self-oiler.
1	20	Kester.
1	40	Western Elec., M.P.
2	40	Lundell, M.P.
3	40	Westinghouse, M.P.
1	50	Am. Engine Co., M.P.
1	60	Maine, M.P.
1	120	General Electric, M.P.
2	125	Crocker-Wheeler, M.P.

500 VOLT MOTORS

H.P.		
1	1	Crocker-Wheeler.
1	1	Towle.
1	1	New England.
1	1½	Belknap, self-oiler.
1	1½	Crocker-Wheeler.
3	2	Western Electric.
1	2	Crocker-Wheeler.
1	2	Lundell.
1	2	Gen. Elec., I. B.
1	3	Western Electric.
1	3	T. H., self-oiler.
1	3½	Roth.
1	4	Fort Wayne.
1	5	Card.
1	5	Browning, M.P.
1	5	Kester.
3	5	Crocker-Wheeler.
1	7½	Edison.
1	7½	Roth, self-oiler.
2	7½	Gen. Elec., M.P.
1	7½	Eddy, M.P.
1	7½	Crocker-Wheeler.
2	10	Kester, M.P.
2	10	Belknap, M.P.
1	12	Thomson-Houston.
1	15	Kester, M.P.
2	20	Bernard, M.P.
1	25	Belknap.
1	25	Gen. Elec., M.P.
1	33	Ft. Wayne, M.P.
1	35	Card, M.P.
1	40	Crocker-Wheeler, M.P.
1	50	Eddy, M.P., type G.
1	65	Gen. Elec., M.P.
1	100	Westinghouse, M.P.
1	125	Siemens & Halske, M.P.

SINGLE PHASE, 125-133 CYCLES

H.P.		
1	1-16	Paragon, 220 v.
1	1	Wagner, 104 volts, auto.
1	1½	Holtzer-Cabot.
1	2	Wagner, auto, 110 volts.
1	3	Gen. Elec., 110 volts, with condenser-compensator.
1	3½	Century, 110 or 220 volts, auto.
1	4	Gen. Elec., 110 volts, with condenser-compensator.

SINGLE PHASE, 60 CYCLE

H.P.		
1	¼	Wagner, 110 v., auto.
1	½	Century, 110 or 220 v.
1	1	Wagner, 110 v., auto.
1	2	Century, 110 or 220 v., auto.
1	2	Wagner, 208 v., auto.

TWO PHASE, 60 CYCLE

H.P.		
1	100	Westinghouse, type C, 220 v., with auto-starter.

THREE PHASE, 60 CYCLE

H.P.		
1	1	General Electric, 110 v.
2	2	General Electric, 110 v.
1	3	Gen. Elec., 110 v., type T. I.
3	10	Gen. El., 550 v., form L.
2	10	Gen. El., 550 v., form K.
1	30	Gen. El., 110 v., form A.
1	30	Gen. El., 220 v., form A.
1	30	Gen. El., 220 v., form L.
1	50	Gen. El., 220 v., form K.
3	150	Gen. El., 550 v., form L, 3 bearings.
1	150	Gen. Elec., 3150 v., type A. T. B., Synchronous with d. c. exciter.
1		Complete Gen. Electric marble switchboard, with instruments for above.

STEAM ENGINES

H.P.		
1	35	Westinghouse, 8½x8 in., vertical automatic.
1	40	Leffel, 9x12, center crank, with Pickering governor.
1	150	Ide cross-compound horizontal, 11 and 17x14, flywheel, 66x17.
1	150	Ideal, latest type, 14x14.

MOTOR GENERATORS AND BOOSTERS, ETC.

H.P.		
1	½	Crocker-Wheeler, 500 v., direct to 75 v., 1 amp., alternating current for telephone ringing.
1	½	Crocker-Wheeler, 500 v., direct to 110 v. alternating, for telephone ringing, 17 cycles.
1	1	Western Elec., dynamotor, 220 v. direct to 26 v., 20 amp., direct current for charging batteries, etc.

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15 K.W. Lundell generator D. C. to Case Engine, 110 volts.
100 K.W. Bullock Generator, 500 volts.
100, 200 and 500 K.W. G. E. belted 550-volt generators.
100 K.W. belted Crocker Wheeler, 250 volt.
30 K.W. Triumph, 220-volt generator.
50 Lt. L. D. T. H. Series arc dynamo and 46 double lamp.
50 H.P. Lundell 500-volt motor.

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90 K.W. G. E., 125 cy., type A. S. alt.
80 K.W. Stanley, 60 cy., 2 ph. alt.
Two 80 H.P. H. T. Boilers.
50 K.W. T. H., 250 v. Gen.
35 K.W. Sprague 6 pole, 250 v. Gen.
50 H.P. C. & C., M. P., 230 v. Motor.
30 H.P. G. E., 60 cy., 2 ph., 200 v. Motor.

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(*Continued from page 70.*)

WANTED.—Four 3rd class subinspectors (electrical), $3.04 per diem. A competitive examination will be held for the above positions July 11, 1906. For further information address "Commandant, Navy Yard, Brooklyn, N. Y."

WANTED.—Thoroughly capable man acquainted with all details relative to manufacture of insulated wire. Must be familiar with rubber compounds required for the purpose. Address "Insulato," care Chesman, Temple Court, New York.

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WANTED.—Two first-class, energetic salesmen. Men with credentials, a thorough knowledge of lighting supply business as to material and selling prices, can effect permanent lucrative connections; one for Pittsburg city, and one for northwestern Pennsylvania, western New York and eastern Ohio. Applicants state concisely experience, reference and salary required. Address No. 2774, care Electrical World, New York.

WANTED.—Agents in every State to handle exclusive territory on the Cone Gas Generator, which generates coal gas for stationary engine from 25 H.P. up, reducing the cost to one-fifth that of steam power; agents must be conversant with machinery business and devote entire time to the work. Cone Gas Machine Co., 1036 Majestic Bldg., Detroit, Mich.

Position and Want Ads

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Bring Quick Results

PROPOSALS

Finest Water-Power in South Carolina Calhoun Falls for Sale

Under decree of the Court of Equity and for partition among the heirs, will be offered for sale at the Court House in the City and County of Abbeville, South Carolina, on Monday, the first day of October, A. D., 1906, at 12 o'clock M.:

All that tract of land situated in the County of Abbeville, State of South Carolina, and partly in the County of Elbert in the State of Georgia, on both sides of the Savannah River, which intersects the said tract, containing about 12,759 acres in South Carolina, and about 2,364 acres in Georgia. This property is commonly known as Millwood, and was owned by the late James Edward Calhoun. It is now the property of his heirs, and is sold for the purpose of settling the estate.

On this property is located the celebrated Calhoun Falls, otherwise known as Trotter's Shoals, which is probably the largest undeveloped water power in that section.

The tract embraces land on both sides of the River for a space of about two miles, affording the best sites for mills and other industrial enterprises.

The other portion of the tract consists of fine arable lands suitable for planting of all kinds, and contains some of the best lands in the State.

No bid will be received for the property above described for less than $165,000 nor from any person unless at the time of making such bid he shall deposit with the auctioneer the sum of $5,000, either in cash or certified check on some responsible bank, such check to be immediately returned at the close of the action to any unsuccessful bidder, but the check of the successful bidder to be applied as payment on account of the purchase money.

65,000 ORIGINAL TIMBER LANDS, OCONEE COUNTY, SOUTH CAROLINA.

At the same time and place will be offered for sale:

All the right, title and interest of the estate of James Edward Calhoun and of each and every of the heirs thereof in and to

All that tract of land situated in the County of Oconee, State of South Carolina, on the South side of the Chattooga River, butting and bounding to the North on Chattooga River, to the east

PROPOSALS

on lands now or late of Rev. J. West, south on lands now or late of C. Jones and others, Norton and others, and to the West on land of W. R. Davis, and others to a point on Chattooga River near where Battle Creek enters into the said River, measuring and containing in all the sum of 65,000 acres, be the same more or less.

This tract of land is reported to be heavily wooded with virgin forests, and containing timber of all kinds.

No bid will be received for the property above described for less than $10,000, nor from any person unless at the time of making such bid he shall deposit with the auctioneer the sum of $1,000 either in cash or certified check on some responsible bank, such check to be immediately returned at the close of the action to any unsuccessful bidder, but the check of the successful bidder to be applied as payment on account of the purchase price.

TERMS OF SALE. Cash within thirty days after date of sale, with the option to the purchaser to pay one-third cash and the balance in 1 and 2 years, deferred payments to be secured by the bond of the purchaser bearing interest at the rate of 7 per cent. per annum, and mortgage of the premises sold. The purchaser to pay all taxes payable in 1906. All parties interested are referred to the decree herein for further particulars and for a more specific description of the property herein ordered to be sold.

SEALED PROPOSALS (THREE SETS) INdorsed "Proposals for Air Compressors," "Proposals for Power Plant," and "Proposals for Generating Sets," will be received at the Bureau of Yards and Docks, Navy Department, Washington, until 11 o'clock A. M., July 21, 1906, and then and there publicly opened, for 2 air compressors and accessories, boilers and accessories, electrical equipment, pumps and piping and 4 turbo-alternators, engines, generators, switchboard, wiring, etc., respectively, for the Navy Yard, Charleston S. C. Plans and specifications can be seen at the Bureau or will be furnished by the Commandant of the Navy Yard named. MORDECAI T. ENDICOTT, Chief of Bureau, May 31, 1906.

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6203 600 K.W., Stanley generator, 60 cycle, 2 phase, 2,400 volts, 277 r.p.m., direct connected to Williams Vertical triple expansion engine.

6771 Two 500 K.W., Stanley, 60 cycle, 2 ph., 2,400 volts, 100 r.p.m., direct connected to Allis-Chalmers horizontal, cross compound engine, 18 and 36x48.

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1763 1-240 K.W., 2-phase, Stanley, 450 r.p.m., 2,200 volts, 60 cycles.

7626 360 K.W., G. E., 2,300 volts, type A.T., class 12-360-600.

1517 150 K.W., G. E., 2,300 volts, type A.T., class 12-150-600.

60 cycle, 2-phase

8334 Two 225 K.W., Westinghouse, 2,300 volts, 480 r.p.m.

1764 Three 180 K.W., Stanley, 2,400 volts, 660 r.p.m.

8244 60 K.W., Westinghouse, 2,000 volts, 1,800 r.p.m.

60 cycle, Single-phase

8199 225 K.W., Warren, 2,300 volts, 600 r.p.m.

7205 200 K.W., G. E., 2,300 volts, type A.M., class 6-200-450.

1700 150 K.W., Westinghouse, 1,100 volts, 600 r.p.m.

1294 90 K.W., G. E., 2,300 volts, type A.S., class 8-90-900.

1750 75 K.W., Westinghouse, 2,200 volts, class 10-75-720.

125-133 cycle, Single-phase

8333 300 K.W., G. E., 2,300 volts, type A. S.B., 450 r.p.m.

1701 120 K.W., Westinghouse, 2,200 volts, 1,000 r.p.m.

1344 90 K.W., G.E., 2,300 volts, type A6, class 12-90-1250.

1049 60 K.W., Westinghouse, 1,100 volts, 1,650 r.p.m.

1432 25 K.W., T.H., 1,100 volts, type A, class 8-25-1500.

ALTERNATING CURRENT MOTORS

25 cycle, 3-phase and 2-phase

7267 200 H.P., Westinghouse, type C., 375 r.p.m., 3 phase.

1047 75 H.P., Westinghouse, 400 volts, 480 r.p.m., 3 phase.

6315 200 H.P., Westinghouse, 440 volts, 480 r.p.m., 2 phase.

1038 20 H.P., Westinghouse, 110 volts, 720 r.p.m., 2 phase.

60 cycle, 3-phase and 2-phase

6330 150 H.P., G. E., 550 volts, type I., class 8-150-900, 3 phase.

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2 350 K.W., 250 volt General Electric, direct-connected type dynamos; type M.P.S—350—100 R.P.M., with or without engines.
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1 180 K.W. 2 phase, 60 cycle, 1,100—2,200 volt Westinghouse, 514 R.P.M.
1 180 K.W. 3 phase, 60 cycle, 1,100—2,200 volt Westinghouse, 514 R.P.M.
2 150 K.W. General Elec. 1 ph., 133 cycle, 750 R.P.M., 2,300 volts.
1 120 K.W. Westinghouse, 1 ph., 133 cy., 1,000 R.P.M., 2,300 volts.
1 75 K.W. Westinghouse 2 phase, 60 cycle, 720 R.P.M., 220 volts.
1 200 K.W. 250 volt, 6 pole Sprague Lundell.
4 100 K.W. 125-volt Edison, Bi-Polar.
75 K.W., 6 pole, Ft. Wayne, 125 V., 600 R.P.M.
2 60 K.W. 125-volt Edison, Bi-Polar.
1 55-KW. 125-volt, Form H, 4-pole G. E.
1 30 K.W., 4 pole Ft. Wayne, 125 V., 800 R.P.M.
1 20 K.W. 125 volt, Form H, 4 pole, G. E., 700 R.P.M.,
2 9B. 120 light, 6.6 amp. Brush Arc Dynamos. 3 circuit.
Large stock of Direct and Alternating Motors—All Sizes.

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ALL 60 CYCLES AND READY FOR IMMEDIATE DELIVERY

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1—150 K.W. Westinghouse, 2200 volt, three-phase, 900 R.P.M. REVOLVING FIELD.
1—150 K.W. General Electric, 1100 or 2200 volts, three-phase, Type ATB, Class 12-150-600.
1—135 K.W. Stanley, 1200 or 2200 volts, two-phase, 900 R.P.M.
1—100 K.W. General Electric, 2200 volts, three-phase, Type AT, Class 10-100-900.
1— 90 K.W. General Electric, 2200 volts, single-phase, Type AS, Class 8-90-900.
2— 75 K.W. General Electric, 2200 volts, two-phase, Type AQ, Class 8-75-900.
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500 Light Quaker City Generator, 125 Volts, 875 R. P. M. 16-polar.
600 Light Excelsior Four (4) Pole Generator, 125 Volts, 850 R. P. M.
800 Light S. & H. 110 Volt, Four (4) Pole Generator, 1130 R. P. M.
30 K.W., T & H. 220 Volts, speed 1170. — 20 H.P. 500 Volt, speed 800.
20 H.P., C. & C. 220 Volts, 850 R. P. M.

Large stock of small Motors and Generators, Automatic Engines from 10 H.P. to 500 H.P., Boilers, etc.

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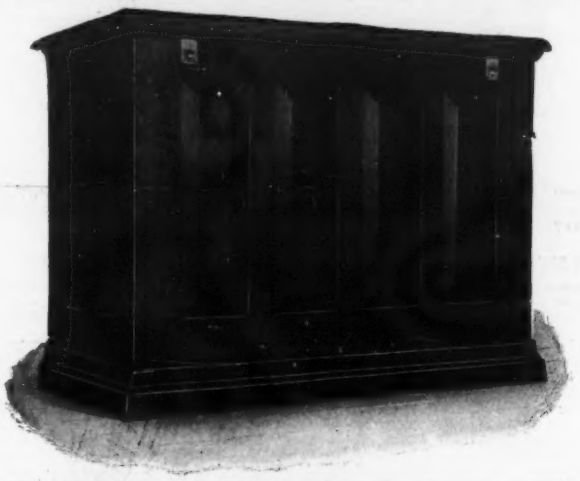

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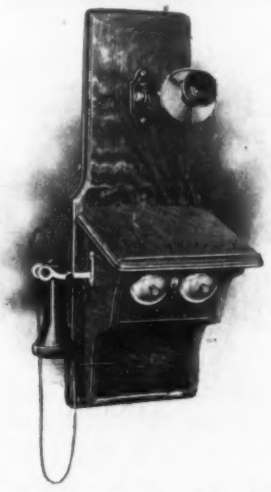

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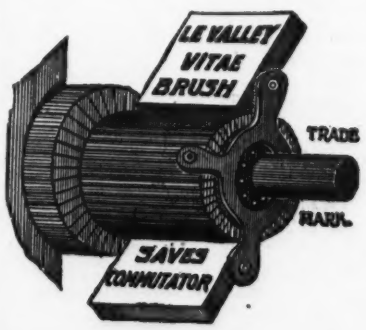

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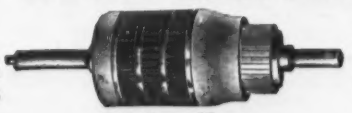

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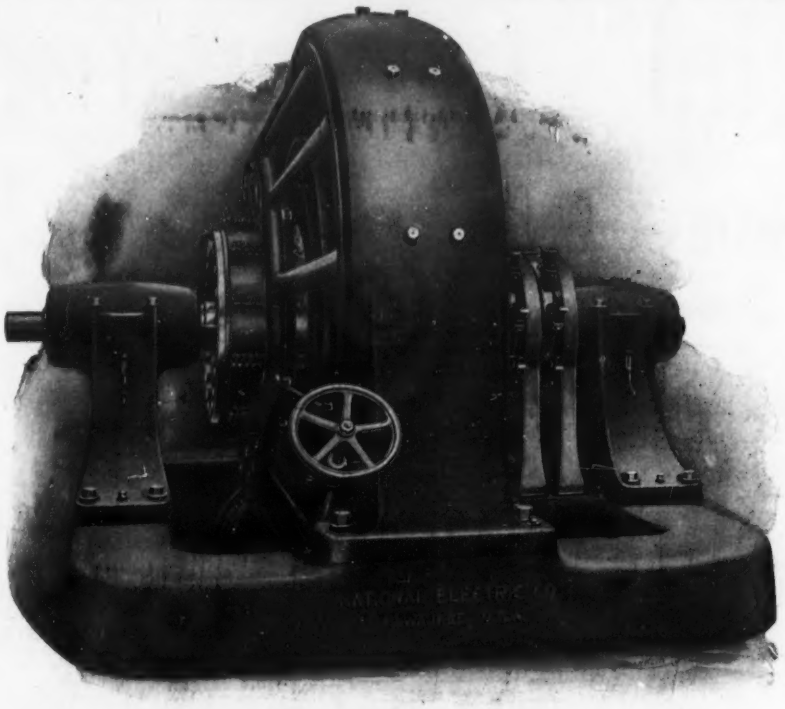

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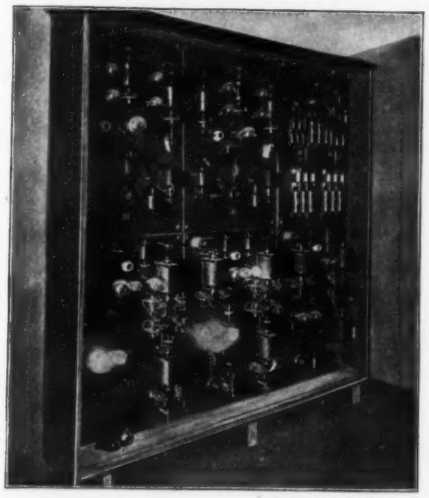

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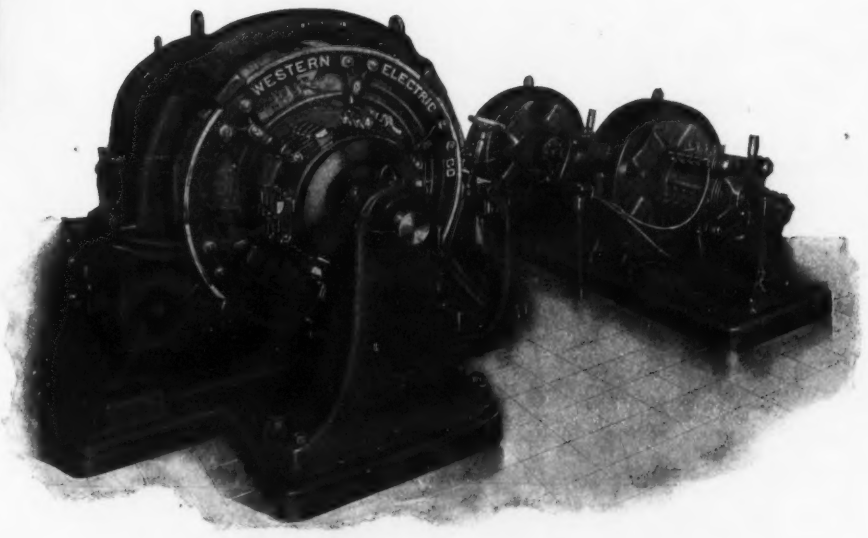

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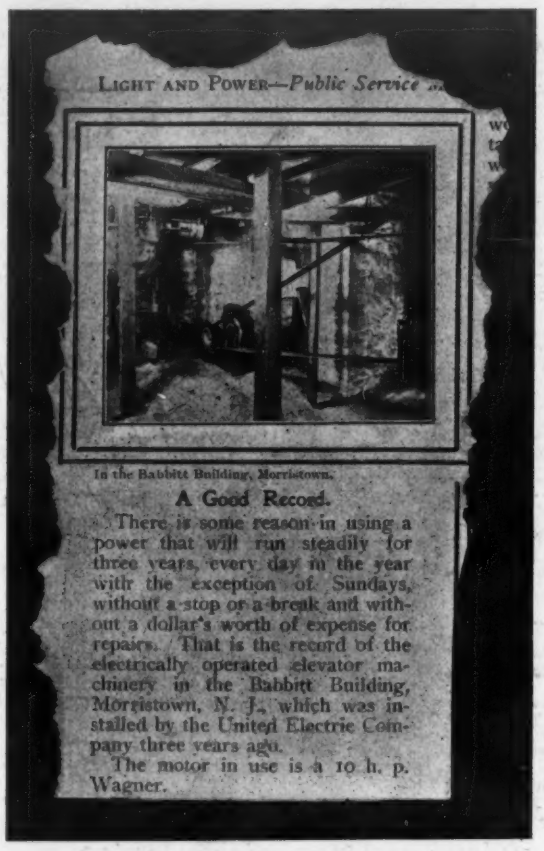
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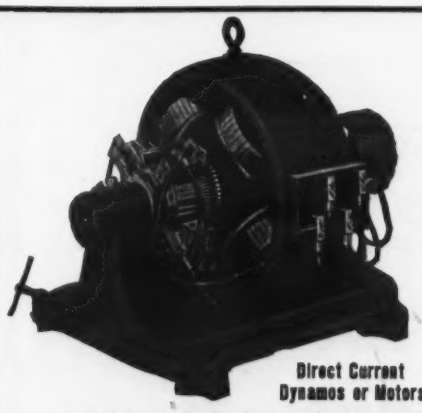

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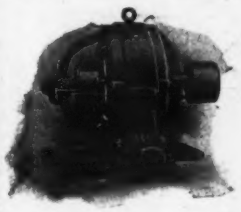

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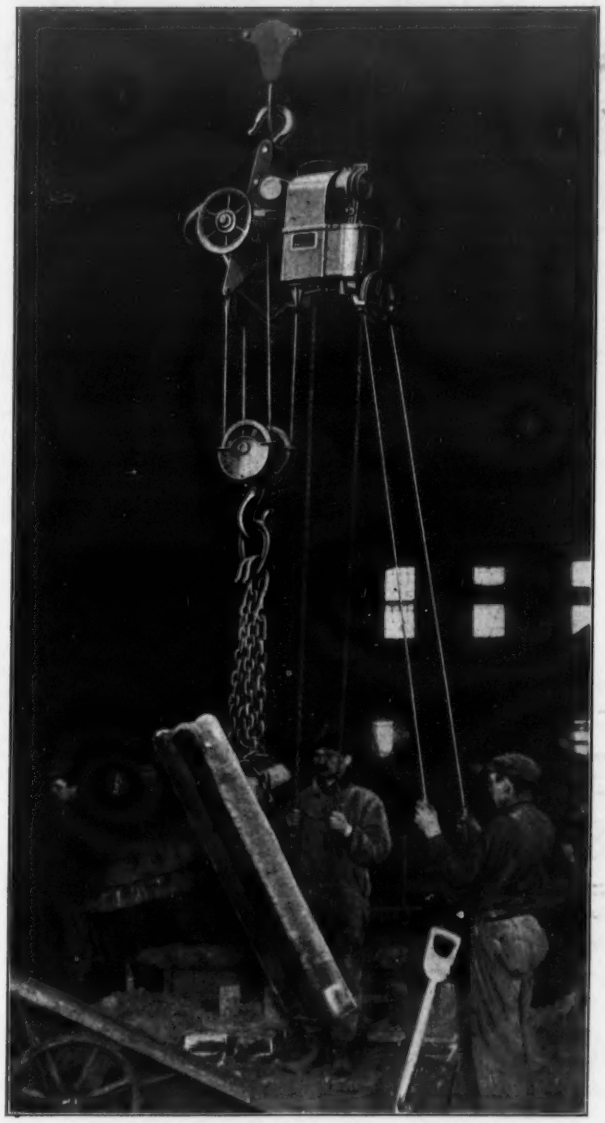

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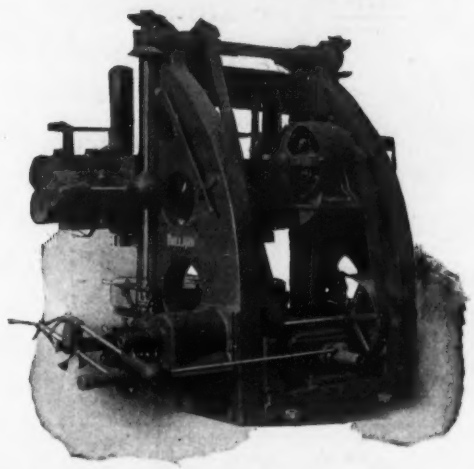

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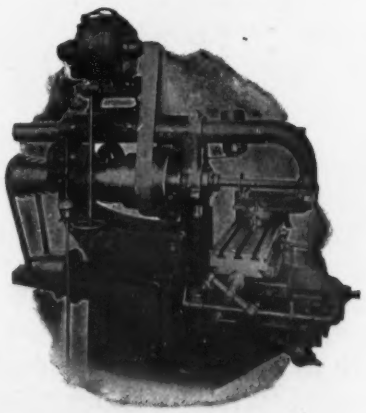

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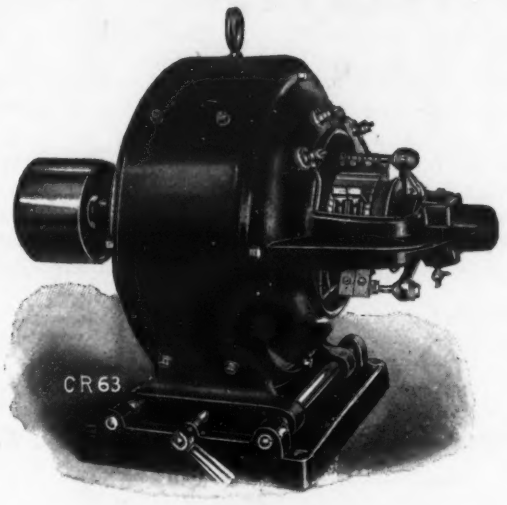

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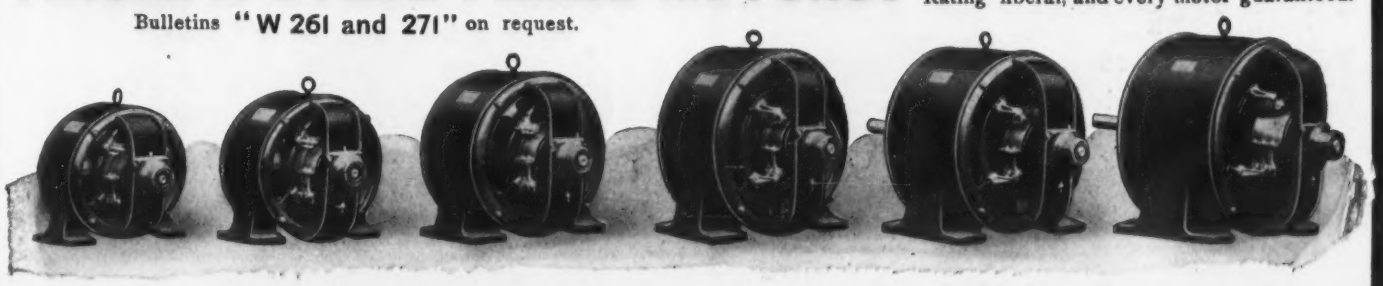

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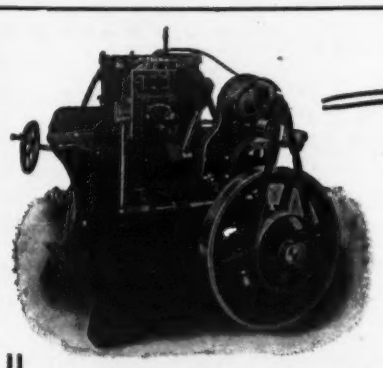

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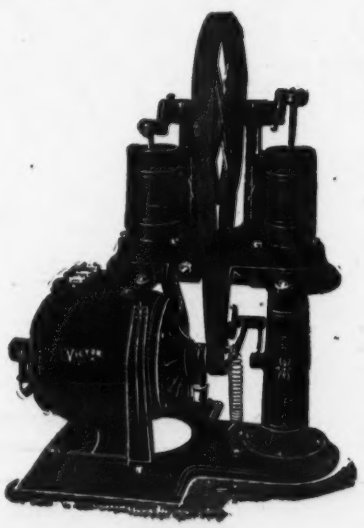

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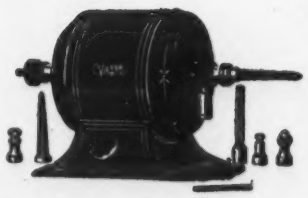

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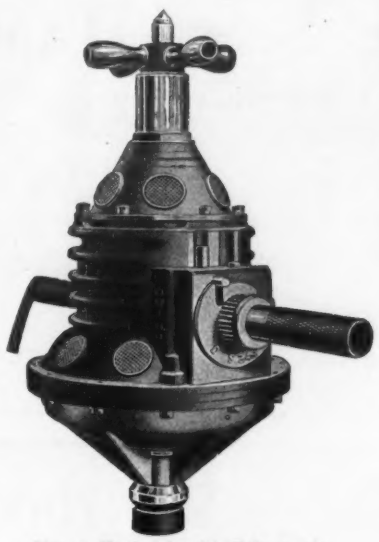

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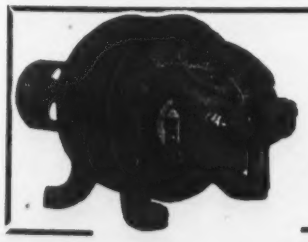

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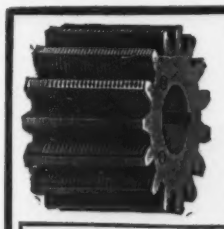

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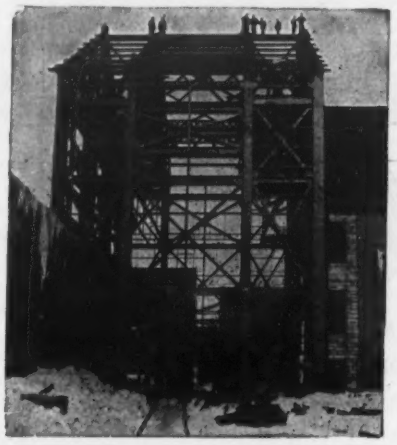

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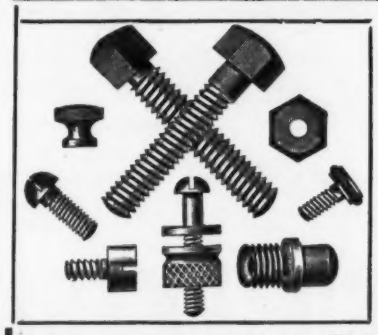

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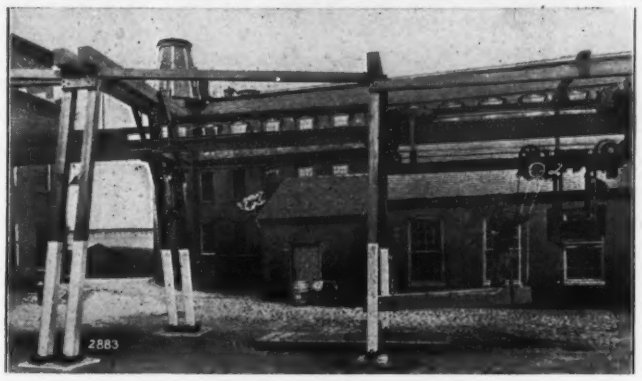

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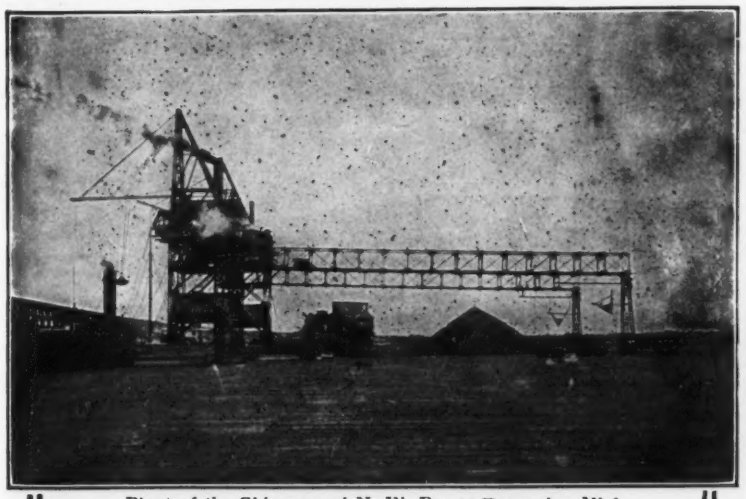

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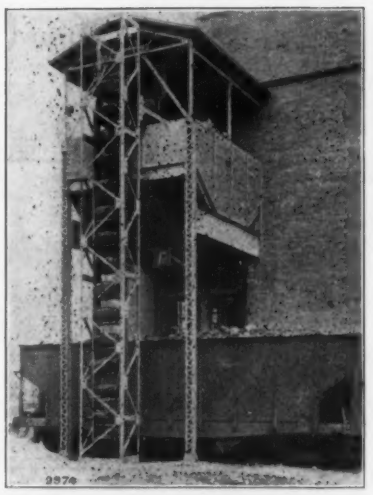

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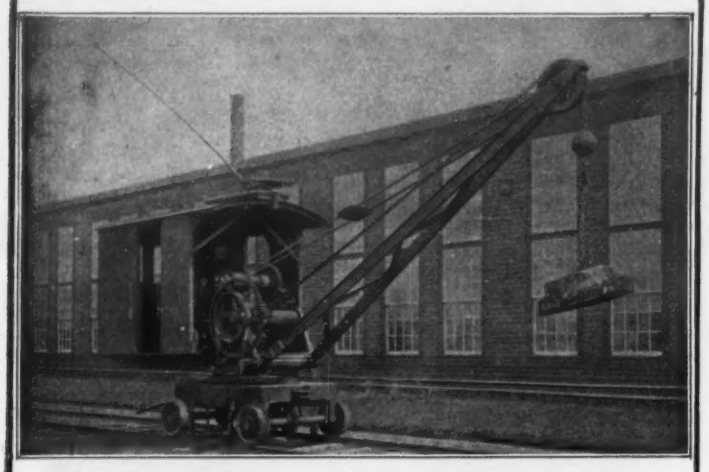

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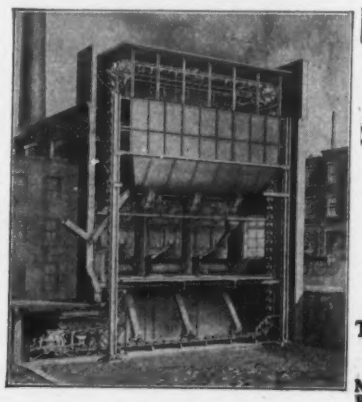

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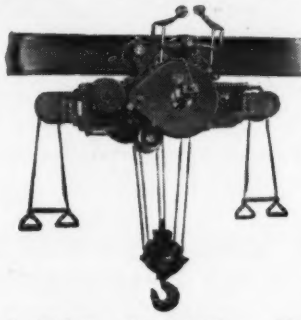

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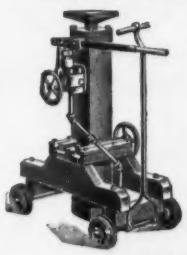

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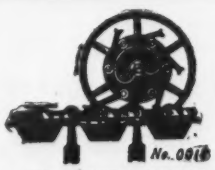

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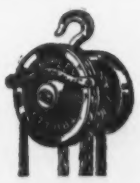

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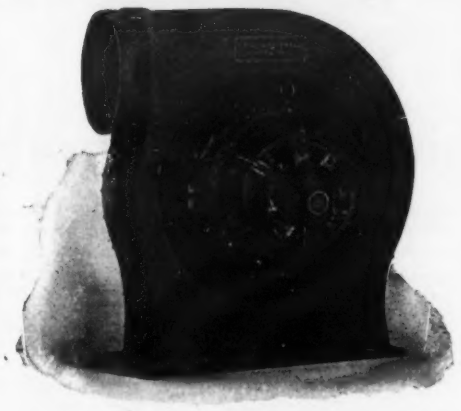

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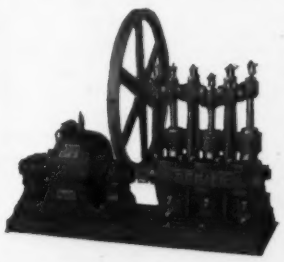

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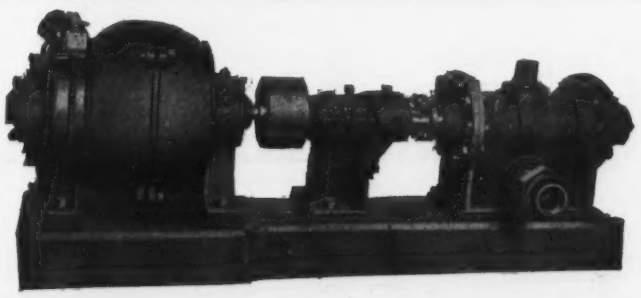

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DUPLEX PISTON METERS

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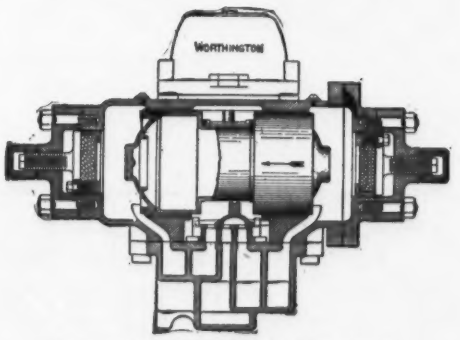

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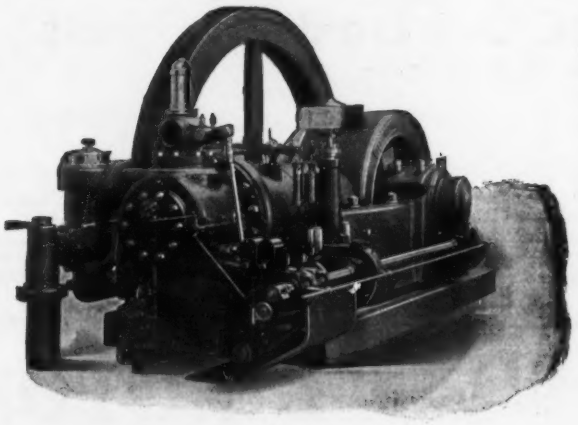
Over 250,000 H. P. in operation



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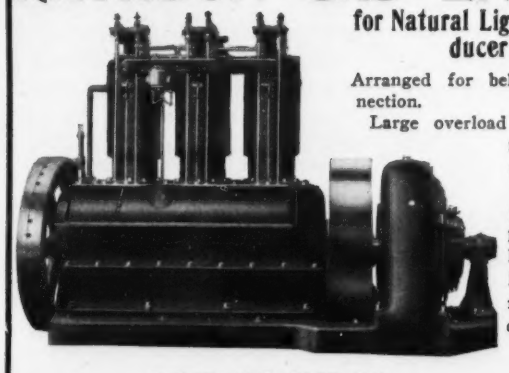

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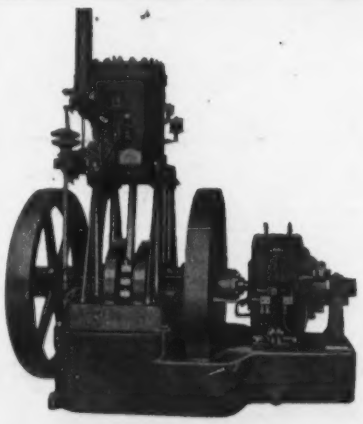

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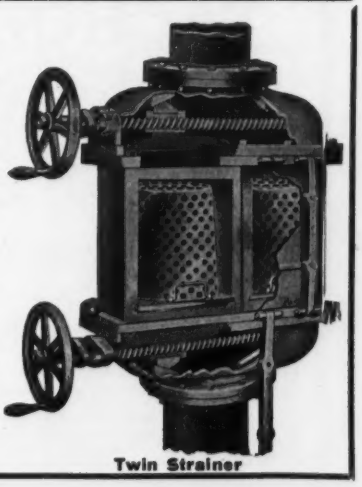

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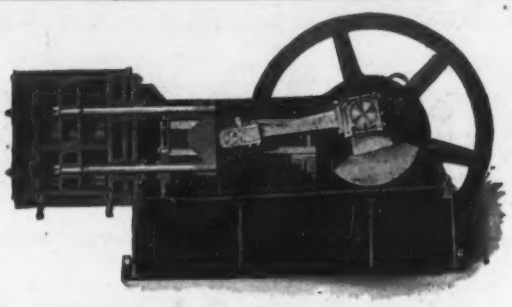

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Observe its compactness, observe the length and the rigid construction of cross head.
Observe the semi-marine type of connecting rod, so convenient to reach.
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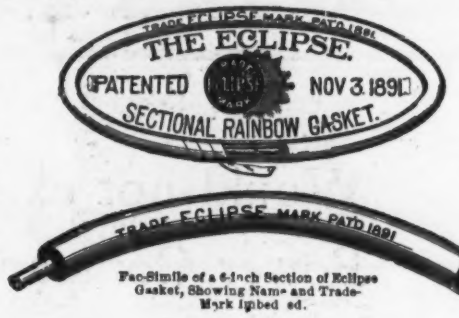

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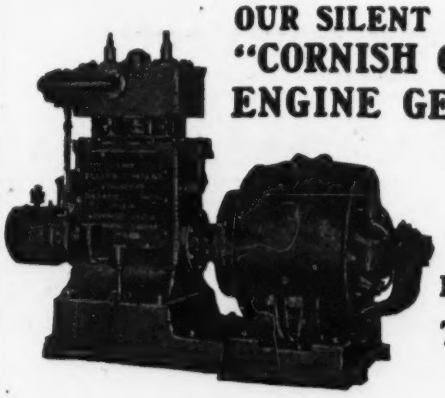

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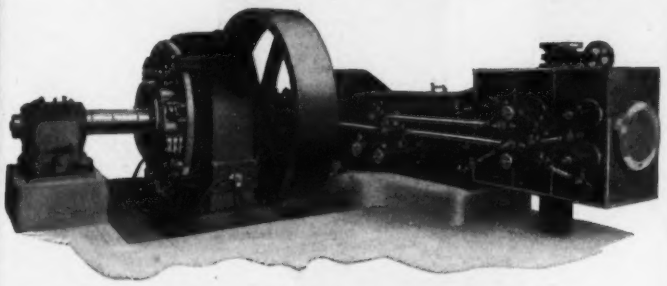

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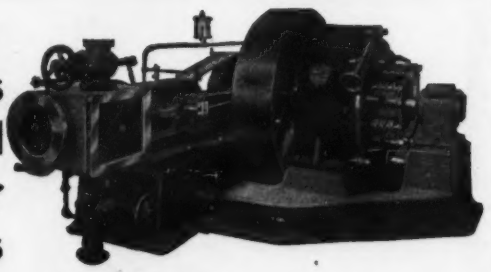

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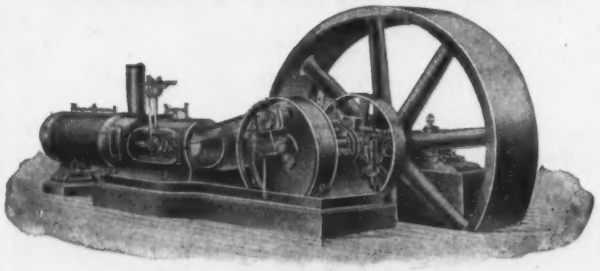

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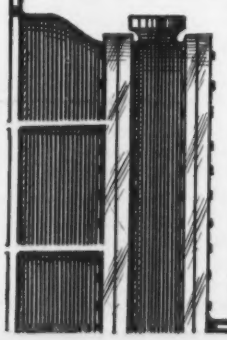

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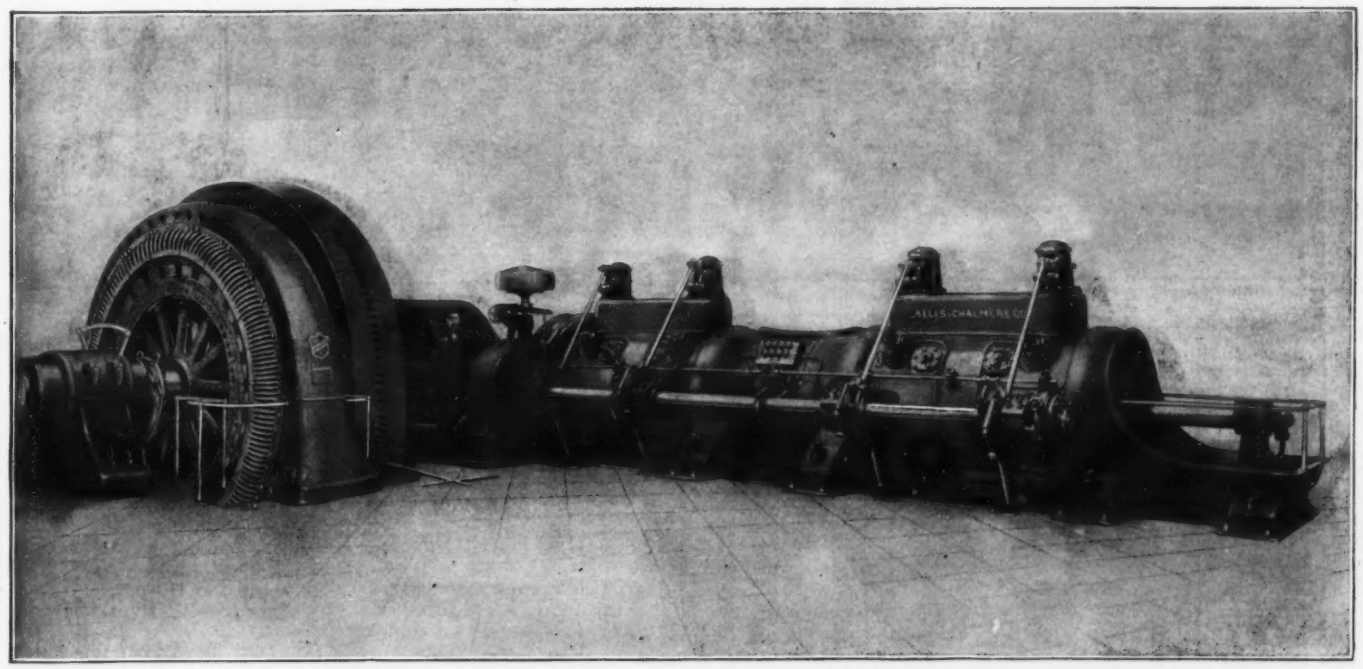

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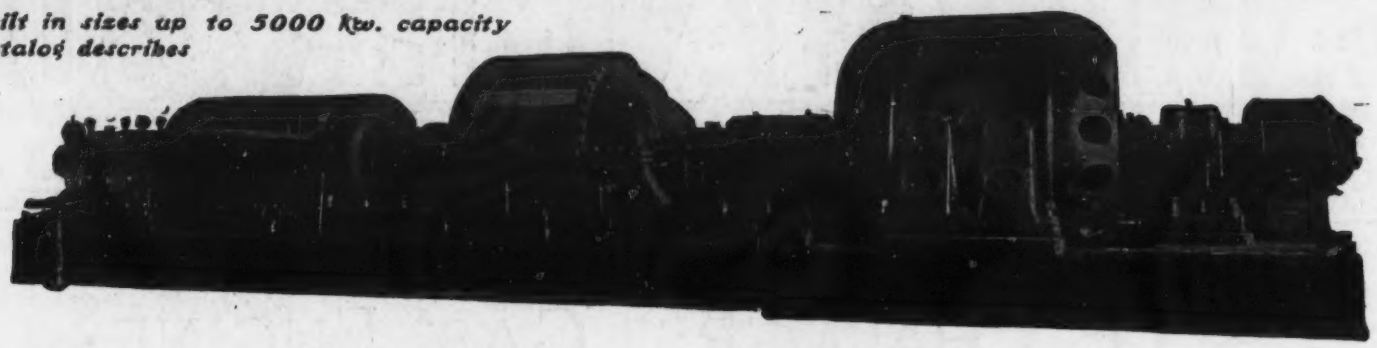

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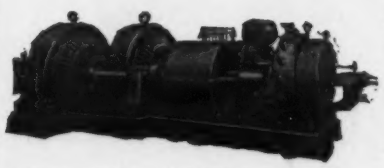

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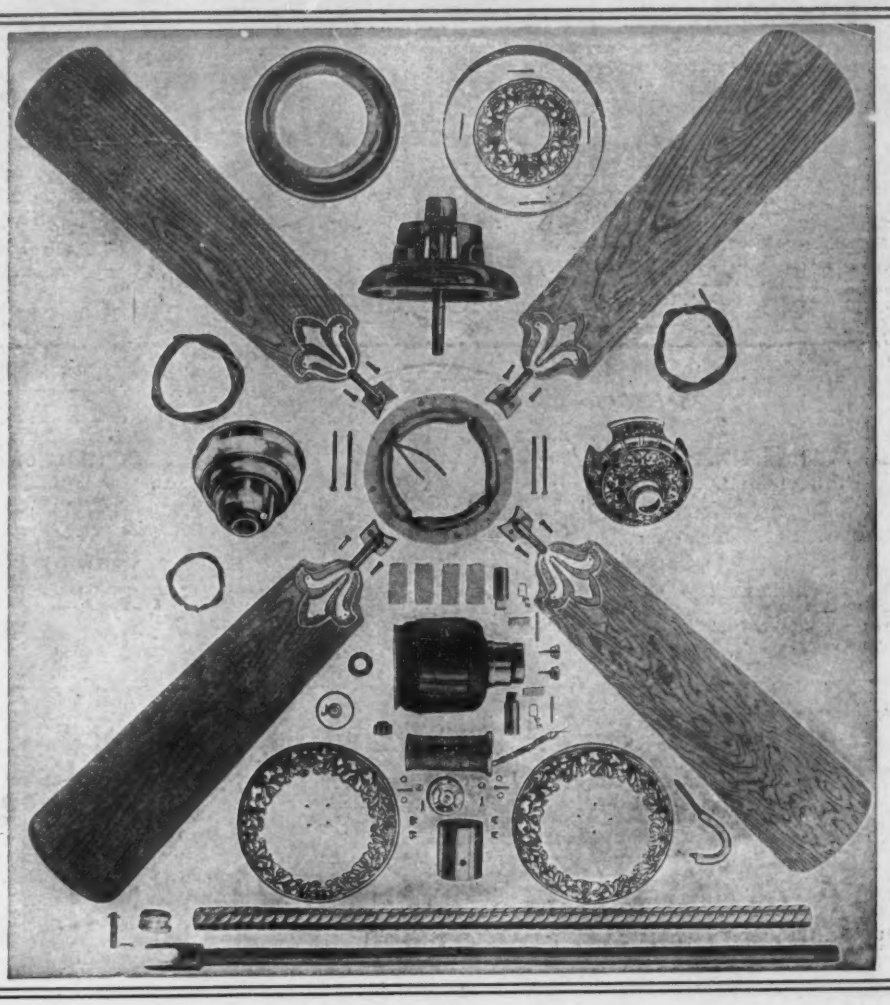

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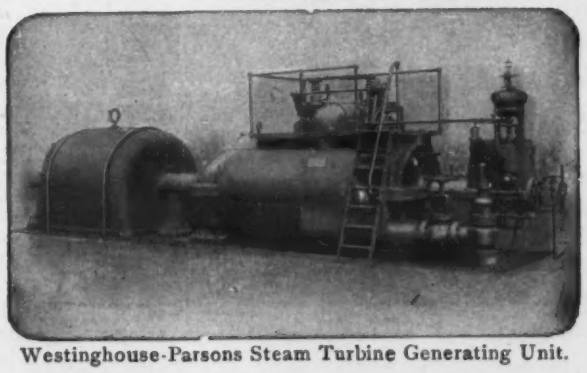

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